Vol. 1

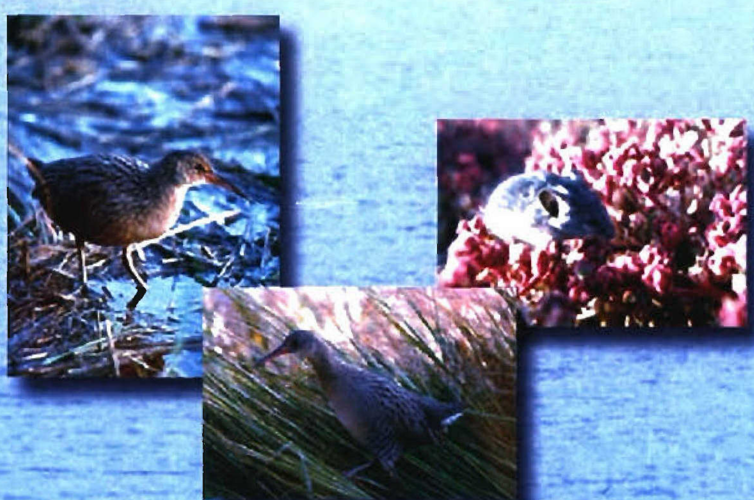
Final General Reevaluation Report
and Technical Appendices

Bel Marin Keys Unit V Expansion of the Hamilton Wetland Restoration Project

April 2003

California State Coastal Conservancy

U.S. Army Corps of Engineers



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The study report provides a general reevaluation of the Hamilton Wetland Restoration Project Authorized in WRDA 1999 and identifies a feasible expansion of the project. The expanded project comprises the beneficial re-use of 24.4 million cubic yards of dredged material to restore a total of 2,526 acres of seasonal and tidal wetland habitat for endangered species on the enlarged 2,600 acre project site which fringes San Pablo Bay, California. Provides for beneficial rescue of the greatest quantity of dredge material and provides critical endangered species habitat in the shortest amount of time.

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333 Market Street, Room 923
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REPLY TO
ATTENTION OF:

CESPD-CM-P (1105) 13 December 2002

MEMORANDUM FOR Commander, U.S. Army Corps of Engineers, ATTN: CECW-B, 441 G Street, NW, Washington, D.C. 20314-1000

SUBJECT: Final General Reevaluation Report of the Hamilton Wetland Restoration Project to include Bel Marin Keys Unit V, California, PWI# 010586

1. Reference: CESPN-PM memorandum dated 12 December 2002, SAB.

2. I concur in the conclusions and recommendations of the District Commander.

ROBERT L. DAVIS
BG, USA
Commanding

BEL MARIN KEYS UNIT V EXPANSION OF THE HAMILTON WETLAND RESTORATION PROJECT

GENERAL REEVALUATION REPORT

Novato, Marin County, California
Final Report
April 2003

Prepared by the
U. S. Army Corps of Engineers
San Francisco District

In cooperation with

The California State Coastal Conservancy
and
The San Francisco Bay Conservation and Development Commission

This document incorporates revisions as of April 2, 2003.

BEL MARIN KEYS UNIT V EXPANSION OF THE HAMILTON WETLANDS RESTORATION PROJECT NOVATO, MARIN COUNTY, CALIFORNIA

EXECUTIVE SUMMARY

Introduction

This study, prepared in cooperation with the non-Federal sponsor, the California State Coastal Conservancy (SCC), provides a general re-evaluation of the Hamilton Wetland Restoration Project (HWRP, authorized in WRDA '99) and identifies a feasible expansion of the project. As authorized, the HWRP will beneficially re-use approximately 10.6 million cubic yards (mcy) of dredged material to restore habitat on 950 of the 988 acres of former Hamilton Army Airfield (HAAF) and the adjacent State Lands Commission (SLC) property. If reauthorized to include the Bel Marin Keys Unit V (BMKV) parcel, the expanded HWRP would beneficially re-use 24.4 mcy of dredged material to restore a total of 2,526 acres of habitat on the enlarged 2,600-acre project site (1,576 acres of habitat on 1,612 acre expansion site). A Supplemental Environmental Impact Report / Environmental Impact Statement (SEIR/EIS) accompanies this General Reevaluation Report.

Location and Study area

The study area is located 25 miles north of San Francisco in the City of Novato, Marin County, California, on the west side of San Pablo Bay (Figure 2-1). The study area covers 2,600 acres including 6 acres of levee easement from the City of Novato and consists of five parcels of land: the 644-acre Hamilton airfield parcel, the 18-acre Navy ballfields, the 319-acre SLC property, the 1,610-acre BMKV parcel, and 2 acres of the 'Bulge' parcel currently owned by the City of Novato (Figure 2-2). The remainder of the original 2,184-acre air base has been sold for private development (except for one area retained by the Coast Guard).

Objectives

Diking or filling tidal areas for land reclamation has destroyed most of the tidal wetlands that historically fringed San Francisco Bay. The project expansion site, which was historically dominated by tidal salt marsh habitat, was converted over the last 150 years to agricultural use. The Hamilton Wetlands Restoration Project is part of the growing effort to restore portions of these former salt marshes and thereby provide increased areas of this threatened vital wildlife habitat. The project is also pivotal to the goals of local resource agencies as expressed in the Long Term Management Strategy (LTMS) for San Francisco Bay. The LTMS sets plans and target goals to maximize the beneficial re-use of dredged material and minimize open water in-bay disposal from navigational maintenance and channel deepening projects. The expanded HWRP site would have a

capacity to accommodate up to 24.4 mcy of dredged material and therefore presents a significant opportunity to facilitate the objectives of the LTMS.

There are two project objectives: (1) create a diverse array of wetland and wildlife habitats that benefit a number of threatened, endangered and other species, and (2) reduce open-water dredged material disposal and beneficially re-use that material to the maximum extent practicable.

The project fulfills both the Federal interest requirements and the needs of the non-Federal sponsor, SCC. The wetland restoration plan formulation involved extensive coordination with SCC, the San Francisco Bay Conservation and Development Commission (BCDC), the City of Novato, various federal and state agencies, organizations, and the public.

Planning Constraints

Two endangered species, the California Clapper Rail and Salt Marsh Harvest Mouse, may be present on portions of the site. While the project would greatly increase habitat for both species, protective measures during certain construction activities, or during nesting periods, may be required to insure no disturbance to the existing salt marsh habitat on the bayside of the levees that these animals may currently occupy.

Another concern is chemical suitability standards for use of dredged material for wetland creation. Only dredged materials that have chemical concentrations and sediment toxicity below levels that could harm wetland biota will be accepted for this project.

The Novato Sanitary District (NSD) outfall pipeline runs through a 20-foot wide easement for two miles along the north boundary of the airfield and south boundary of the SLC property. Currently, along this pipeline on the SCC parcel is a dechlorination facility. This facility will be relocated out of the project area. The New Hamilton Partners (NHP) storm-water discharge outlet must also be protected.

Final Array of Alternatives Considered

No action

Under the No Action Plan, HWRP would proceed as authorized. The BMKV parcel would not be included and delays due to HTRW remediation could occur. The environmental benefits of the proposed expansion project would not be realized.

Alternative 1, Beneficial Reuse of Dredged Material with Expanded Pacheco Pond

This alternative would result in 1,089 acres of wetland habitats and 487 acres of other upland, open water and subtidal habitats, for a total of 1,576 acres of habitat creation. Dredged material would be used to accelerate marsh establishment.

Alternative 2, Beneficial Reuse of Dredged Material with Seasonal Wetlands and Expanded Pacheco Pond

As initially proposed, this alternative would result in 1,249 acres of wetland habitats and 327 acres of other upland, open water and subtidal habitats, for a total of 1,576 acres of habitat creation. However, after review of comments received during the public review period, this alternative was modified. Revised Alternative 2 would result in 1,188 acres of wetland habitats and 388 acres of other upland, open water and subtidal habitats, for a total of 1,576 acres of habitat creation. Dredged material would be used to accelerate marsh establishment and raise elevations for seasonal wetlands.

Alternative 3, Natural Sedimentation

This alternative would result in 1,284 acres of wetland habitats and 292 acres of other upland, open water and subtidal habitats, for a total of 1,576 acres of habitat creation, approximately 50 years in the future. Once outboard levees are breached, tidal sedimentation would slowly fill the tidal portions of the project.

Comparison of Alternatives

Prior to the public review period, Alternative 2 was selected because it provided the greatest diversity of habitat, allowed for most efficient beneficial reuse of dredged material, provided critical endangered species habitat in the shortest amount of time, replaced the greatest amount of seasonal wetland and allowed the greatest degree of operational flexibility. Given all these considerations, Alternative 2 best addressed the study objectives of ecosystem restoration and beneficial reuse of dredged material.

After consideration of the comments provided by agencies, individuals, and organizations on the document, design requirements, and environmental factors and review of the project goals and objectives, Alternative 2 was revised. Chapter 4 provides a comparison of alternatives, including Revised Alternative 2. The analyses show that beneficial reuse of dredged material would provide faster wetland restoration than natural sedimentation. In addition, the use of dredged material would provide a greater diversity of habitat. The project is cost-effective at maximizing outputs, meeting objectives and fulfilling both the Federal interest requirements and the needs of the non-Federal sponsor.

The Selected Plan

Revised Alternative 2, Beneficial Reuse of Dredged Material with Seasonal Wetland and Expanded Pacheco Pond, was selected because it provides the greatest diversity of habitat, allows for beneficial reuse of the greatest quantity of dredged material, provides critical endangered species habitat in the shortest amount of time, and replaces the greatest amount of seasonal wetland. Given all these considerations, Revised Alternative 2 best addresses the study objectives of ecosystem restoration and beneficial reuse of dredged material. Revised Alternative 2 also best addresses the other evaluation criteria of completeness, effectiveness, efficiency, and acceptability, while minimizing ongoing management. Therefore, it is the selected plan.

Summary of Costs

The total project implementation cost for the combined project is the cost to design and construct the project, including dredged material transportation costs that exceed current dredged material hauling costs, as described in Chapter 6 of this report. Total project implementation costs will be shared by the non-Federal sponsor, navigation projects in the San Francisco Bay (both Federal and non-Federal), and the Federal Construction General program.

The total project implementation cost for the combined Hamilton Wetland Restoration Project and Bel Marin Keys expansion project is estimated to be $301,700,000, to be funded as follows: non-Federal sponsor: $47,100,000, Federal and non-Federal navigation projects: $113,400,000, and HWRP/BMKV Federal Construction General funds: $141,200,000. For the combined HWRP and BMKV Expansion Project, the total annual operations and maintenance (O&M) cost would be $886,000.

The navigation projects' contributions must be subtracted from the total project implementation cost to determine the total project first cost. This is necessary to avoid redundant Federal appropriations for these projects. The total project first cost defines the Congressionally authorized project cost.

The total first project cost for the combined project is $188,300,000 under fourth quarter 2002 prices; this figure will form the basis of cost-sharing. The Federal share is currently estimated at $141,200,000. The non-Federal share is currently estimated to be $47,100,000.

The implementation cost of the Bel Marin Keys expansion portion of the project is estimated to be $182,700,000. This cost would be funded as follows: non-Federal sponsor: $33,400,000 ($33,309,260 restoration and $90,740 recreation). Federal and non-Federal navigation projects: $49,100,000, and the Federal Construction General program: $100,200,000 ($100,109,260 restoration and $90,740 recreation). For the BMKV expansion portion, the total annual operations and maintenance (O&M) cost would be $525,000.

List of Acronyms

APE - Area of Potential Effects
BA - Biological Assessment
BCDC - San Francisco Bay Conservation and Development Commission
BMKV – Bel Marin Keys Unit V
BRAC - Base Realignment and Closure Act
BO - Biological Opinion
CAR - Coordination Act Report
CDFG - California Department of Fish and Game
CEQA - California Environmental Quality Act
cfs - Cubic feet per second
Corps - US Army Corps of Engineers
cy - cubic yards
CSD – Bel Marin Keys Community Services District
CZMA - Coastal Zone Management Act
DCAR - Draft Coordination Act Report
DMMO - Dredged Material Management Office
EIR - Environmental Impact Report
EIS - Environmental Impact Statement
EIS/R - Environmental Impact Statement/Report
- **DEIS/R** - Draft Environmental Impact Statement/Report
- **FEIS/R** - Final Environmental Impact Statement/Report
- **SEIS/R** – Supplemental Environmental Impact Statement/Report

EO - Executive Order
EPA - Environmental Protection Agency
EQ - Environmental Quality
ER - Engineering Regulation
ERA - Ecological Risk Assessment
ESA - Endangered Species Act
FCSA - Feasibility Cost Sharing Agreement
FUDS - Formerly Utilized Defense Sites
FWS - Fish and Wildlife Service
FY - Fiscal Year
GRR – General Reevaluation Report
HAAF - Hamilton Army Air Field
HEP - Habitat Evaluation Procedure
HRG - Hamilton Restoration Group
HTRW - Hazardous, Toxic and Radiological Waste
HU - Habitat Unit
HWRP – Hamilton Wetland Restoration Project
IDC - Interest During Construction
IDIQ - Indefinite Delivery, Indefinite Quantity
LERRDS - Lands, Easements, Rights of Way, Relocations, and Disposal Sites
LGVSD - Las Gallinas Valley Sanitary District
LTMS - Long Term Management Strategy

MCACES - Corps of Engineers Micro Computer Aided Cost Estimating System
MCFCWCD - Marin County Flood Control and Water Conservation District
mcy - million cubic yards
MHW - Mean High Water
MHHW - Mean Higher High Water
MLW - Mean Low Water
MLLW - Mean Lower Low Water
NED - National Economic Development
NEPA - National Environmental Policy Act
NGVD - National Geodetic Vertical Datum of 1929
NHP - New Hamilton Partnership
NOAA - National Oceanic and Atmospheric Administration
NMFS - National Marine Fisheries Service
NSD - Novato Sanitary District
O&M - Operations and Maintenance
OMRR&R - Operation, Maintenance, Repair, Replacement and Rehabilitation Requirements
OSE - Other Social Effects
PAC – Post-Authorization Change
PCA - Project Cooperation Agreement
PED - Pre-Construction Engineering and Design
P&G – US Water Resources Council's Principles and Guidelines
PG&E – Pacific Gas and Electric
PSP - Project Study Plan
RED - Regional Economic Development
RWQCB - San Francisco Bay Regional Water Quality Control Board
SCC - California State Coastal Conservancy
SHPO - State Historic Preservation Officer
SLC - California State Lands Commission
USACE - United States Army Corps of Engineers
WRDA - Water Resources Development Act

BEL MARIN KEYS UNIT V EXPANSION OF THE HAMILTON WETLAND RESTORATION PROJECT

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GENERAL REEVALUATION REPORT

BEL MARIN KEYS UNIT V EXPANSION OF THE HAMILTON WETLAND RESTORATION PROJECT NOVATO, CALIFORNIA

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this General Reevaluation Report (GRR) is to perform feasibility-level analysis to evaluate potential Federal interest in reauthorizing the Hamilton Army Airfield Wetland Restoration Project (HWRP, authorized in WRDA 1999) to expand habitat restoration by including Bel Marin Keys V (BMKV), located along San Pablo Bay in Marin County, California. This report summarizes the reevaluation study process and results of the study effort. The alternative formulation and evaluation process builds on the alternative formulation previously conducted for the HWRP. Project feasibility is assessed in terms of physical, environmental, and economic considerations. This report also reevaluates the previously authorized HWRP, addressing implementation costs that have been adjusted and updated since project authorization.

The 1998 Feasibility Study for HWRP extended over a study area of 988 acres along San Pablo Bay, including the Hamilton Army Airfield property (HAAF) and the State Lands Commission property (SLC). The addition of BMKV would add 1,610 acres along San Pablo Bay and 2 acres to the west of HAAF, for a total area of 2,600 acres. Federal interest requires that a proposed project be in accordance with U.S. Water Resources Council's Principles and Guidelines (P&G), comply with applicable environmental laws and statutes, and have the support of a non-Federal sponsor who is willing and able to participate in the cost-sharing requirements for project implementation. The non-Federal sponsor for the Hamilton Wetlands Restoration Project is the California State Coastal Conservancy (SCC). The SCC is also the sponsor for this GRR, and would sponsor the expanded HWRP if Congress authorizes the proposed addition of BMKV. The San Francisco Bay Conservation and Development Commission (BCDC) is also participating in this GRR in an advisory capacity.

1.2 PROJECT AUTHORITY

The 1998 Hamilton Wetlands Restoration Project Feasibility Study was authorized by a resolution adopted by the United States Senate Committee on Environment and Public Works, dated October 29, 1997, that requested the Secretary of the Army to review the report of the Chief of Engineers on San Francisco Bay and Tributaries, California, dated December 21, 1976, and any other pertinent reports, with a view to determining whether any modification of the recommendations contained therein were advisable at that time, in the interest of ecosystem protection and restoration, including restoring tidal and

seasonal wetlands and related purposes, at the Hamilton Army Airfield and adjacent properties on San Pablo Bay, Marin County, California.

The Hamilton Wetlands Restoration Project was authorized in Section 101(b) of WRDA 1999, which specifies:

"(b) PROJECTS SUBJECT TO A FINAL REPORT. The following projects for water resources development and conservation and other purposes are authorized to be carried out by the Secretary substantially in accordance with the plans, and subject to the conditions, recommended in a final report of the Chief of Engineers if a favorable report of the Chief is completed not later than December 31, 1999: . . . (3) Hamilton Airfield, California – The project for environmental restoration, Hamilton Airfield, California, at a total cost of 55,200,000, with an estimated Federal cost of $41,400,000 and an estimated non-Federal cost of $13,800,000."

1.3 Planning Process

The Corps of Engineers planning process consists of six steps; these are set forth in the P&G and are repeated throughout a study as new and more detailed information is developed. The six planning steps are (1) specify problems and opportunities, (2) inventory and forecast conditions, (3) formulate alternative plans, (4) evaluate effects of alternative plans, (5) compare alternative plans, and (6) select a recommended plan. The results of this process, presented in the Hamilton Wetland Restoration Plan and this GRR, were developed jointly with the SCC and BCDC. Coordination with other agencies was performed throughout this study to ensure that problems, concerns, and opportunities that could be addressed through water and related land resources planning received the broadest possible attention. The Corps, SCC and BCDC team members have coordinated closely with city and county governments, as well as representatives of the Bel Marin Keys residential community. The Hamilton Restoration Group (HRG) met regularly to identify and resolve issues related to wetland restoration at Hamilton Field. Meetings with the HRG and the BMKV stakeholders group have continued during this phase of the study. Input from the HRG was solicited by the SCC's consultant team and was incorporated into the design for both HWRP and BMKV. The team completed the *Draft Hamilton Wetlands Conceptual Restoration Plan* in April of 1998, and the *Draft Bel Marin Keys Conceptual Restoration Design Technical Report* in March 2002.

1.4 Prior Studies and Reports

There have been numerous prior studies and reports related to this project. Those most relevant are listed below. Additional prior studies and reports relevant specifically to the environmental evaluation are listed in the 1998 *Hamilton Wetland Restoration Plan Environmental Impact Statement/Environmental Impact Report (EIS/EIR).* A supplemental Environmental Impact Statement/Environmental Impact Report (SEIS/R) was completed for the proposed expansion of the HWRP. Additional references can be found in this document.

a. *Section 204 Initial Appraisal for the Bel Marin Keys Unit 5 Wetland Restoration Project.* San Francisco District, U.S. Army Corps of Engineers, San Francisco, CA. September 2000. This document was prepared in accordance with the Water Resources Development Act of 1992, and was submitted to the Commander, U.S. Army Corps of Engineers. The Initial Appraisal report documented the preliminary engineering and economic review of the addition of BMKV, and concluded that adding BMKV would represent a cost-effective, feasible extension to the Hamilton project.

b. *Hamilton Wetland Restoration Plan, Volume I: Feasibility Report and Volume II: Final EIS/EIR.* December 1998. California State Coastal Conservancy and U.S. Army Corps of Engineers, San Francisco District. The Feasibility Report for the Hamilton Wetland Restoration Project Volume describes the plan formulation process for the project, presents the incremental analysis of the project alternatives, and recommends a restoration plan. The study concluded that there is a federal interest in the project, based on both the ecological benefits of habitat restoration, and the ecological benefits of beneficial reuse of dredged sediment. Portions of Volume I are excerpted for reference in this GRR. Volume II analyzes the potential environmental effects of restoring the Hamilton Army Airfield and adjacent properties to tidal marsh. The EIS/R concluded that with implementation of mitigation, all potential impacts would be less than significant.

c. *Final Environmental Impact Statement Hamilton Army Airfield Disposal and Reuse Vol. 1 and Vol. 2.* February 1996. Sacramento District, U.S. Army Corps of Engineers, Sacramento, CA. Technical assistance from Jones & Stokes Associates, Inc. The potential environmental effects of reuse including the effects of the proposed disposal action are described in Volume One of this report. A description of the affected environment, environmental consequences and mitigation measures are provided for thirteen resources. The abstract provided in the beginning of the document states that the disposal action would result in the loss of federally protected wildlife and sensitive plant communities, historic structures, and risk of flooding from reduced maintenance of flood protection facilities. The abstract also states that reuse could result in a range of impacts including loss of wetlands and destruction of cultural resources. Section 4. 11 of this report provides an overview of the biological resources at HWRP. Table E-1 and E-2 are lists of plants and wildlife observed at HWRP. Volume 2 includes Responses to Comments.

d. A Section 204 *Initial Appraisal of the Hamilton Army Airfield Wetland Restoration Project,* prepared in accordance with the Water Resources Development Act of 1992, was submitted to the Commander, U.S. Army Corps of Engineers, in December 1997. The appraisal, which contained the information necessary to enter into Project Study Plan (PSP) negotiations for a cost-shared feasibility study, was submitted with the recommendation that it be considered as an Expedited Reconnaissance Study 905(b)(WRDA 1996) Preliminary Analysis. In that same month, USACE Headquarters approved the appraisal as the reconnaissance level document providing the basis for proceeding into the feasibility phase of planning under the General Investigations

program. The reconnaissance phase resulted in the execution of a Feasibility Cost Sharing Agreement (FCSA) on April 8, 1998.

e. Draft document, *Hamilton Wetlands Conceptual Restoration Plan*, April 1998. Woodward Clyde, Inc,. in collaboration with H.T. Harvey and Associates, Eric Polson, Philip Williams and Associates, Ltd., SCC, the City of Novato and the Bay Conservation and Development Commission (BCDC). This document presents the physical and biological design for the tidal marsh recommended for the Hamilton Wetlands Restoration Plan.

f. *The Long Term Management Strategy for Bay Area Dredged Material Final Programmatic EIS/EIR* was published in October 1998. It was a joint effort by the U.S. Army Corps of Engineers (Corps), the U.S. Environmental Protection Agency (EPA), the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB), BCDC and the State Water Resources Control Board (SWRCB). These agencies joined together with navigation interests, fishing groups, environmental organizations, and the public in a cooperative effort to establish a comprehensive Long-Term Management Strategy (LTMS) for Bay Area dredged material. Three alternative long-term approaches were evaluated in this EIS/EIR. Each of these alternatives includes a more balanced distribution of dredged material disposal in a combination of all three of the potential placement environments: at existing sites within the Estuary, offshore in the Pacific ocean, and at a variety of upland or wetland disposal or reuse sites. The LTMS goal is to conduct necessary dredging and dredged material disposal in an environmentally sound and economically prudent manner, to maximize the beneficial reuse of dredged material and to develop a coordinated permit review process for dredging projects. The HWRP was evaluated as part of a comprehensive review by the LTMS agencies of potential sites for reuse and was found to be a very suitable site for wetland restoration using dredged material.

g. *Conceptual Design for Tidal Wetland Restoration for the Hamilton Army Airfield.* Philip Williams and Associates, 1998.

1.5 Report Organization

The six planning steps presented in the U.S. Water Resources Council's Principles and Guidelines form the basis of organization for this feasibility-level GRR. Chapter 2, Problem Identification, provides a description of the study area and describes the problems, opportunities and constraints associated with the addition of Bel Marin Keys Unit V to the Hamilton Wetland Restoration Project. In Chapter 3, Plan Formulation, the objectives are developed and, to address the identified problems and opportunities, alternative plans are formulated. Chapter 4 evaluates and compares the alternative plans and Chapter 5 presents the selected plan. A summary of the post-authorization changes is presented in Chapter 6. Coordination and public involvement are discussed in Chapter 7 and the study conclusions and recommendations are presented in Chapter 8.

2.0 PROBLEM IDENTIFICATION

2.1 General

This section presents the results of the first and second major steps in the planning process, the specification of water and related land resources problems and opportunities, and the forecast and analysis of water and related land resources in the study area. Presented is a description of the affected environment, problems and opportunities, and planning constraints. The problems this project addresses are: 1) the regional decline in tidal marsh habitat, and 2) constraints on dredged material disposal capacity in the Bay Area due to environmental and navigation concerns. Opportunities that the project would realize include endangered species habitat restoration and beneficial reuse of dredged material. Addition of the BMKV parcel would substantially enhance the opportunities at the HWRP, increasing the ability of the project to provide endangered species habitat as well as to beneficially reuse dredged material. Operational flexibility and value engineering opportunities would also be realized if the HWRP were expanded to include the BMKV parcel. References are provided in PWA, 1998, as documented in Section 1.4.

2.2 Study Area Description

The Hamilton Wetlands Restoration Project and Bel Marin Keys Unit V are located 25 miles north of San Francisco on the southeast edge of the City of Novato, Marin County, California (Figure 2-1). San Pablo Bay is adjacent to HWRP and BMKV on the southeast side. Properties owned by the St. Vincent Catholic Youth Organization and Las Gallinas Valley Sanitary District lie to the south, while the Bel Marin Keys I-IV residential community and Novato Creek border the north. The Novato Sanitary District's sewer outfall pipeline runs along the border of the HAAF site and the SLC and BMKV properties. Five Pacific Gas and Electric (PG&E) high voltage power line towers on the Vaca-Ignacio Line are located on the BMKV parcel (Figures 3.1-3.3). These properties historically supported tidal salt marsh habitat, but levee construction separated the area from the tidal influence of San Pablo Bay. Desiccation of the native Bay Mud soils and human activities have resulted in lowered surface elevations.

The term 'study area' refers to the area that would be affected to a significant degree by implementation of any of the alternative plans considered in this study. The study area for the reauthorization (Figure 2-2) includes the authorized HWRP project area as well as the proposed BMKV expansion area and consists of five parcels of land: (1) the 644-acre HAAF parcel (HWRP), (2) the 18-acre Navy Ball Fields to the southwest (HWRP), (3) the 319-acre State Lands Commission property (former Hamilton Antenna Field, HWRP) to the northeast, (4) the 1,610-acre SCC property (BMKV) to the northeast, and (5) 2 acres of the "Bulge" property to the west of HAAF, currently owned by the City of Novato. These five parcels occupy 2,600 acres, including 6 acres of levee easement from the City of Novato and 0.76 acre for pipeline placement to be provided through the Navigation Servitude. The remainder of the original 2,184-acre air base is outside the project footprint, and is being developed as residential, light industrial, and open space areas. A summary of the proposed changes to the authorized HWRP as a result of the BMKV expansion is presented in Chapter 6. Note, for the SEIR/EIS, project

effects on Novato Creek, Pacheco Pond, Arroyo San Jose, and Pacheco Creek were assessed in issue areas where such off-site effects were identified to occur. Thus the study area for the individual subject areas was broader than the expansion site itself in areas such as hydrology and tidal hydraulics and water quality.

2.3 EXISTING CONDITIONS

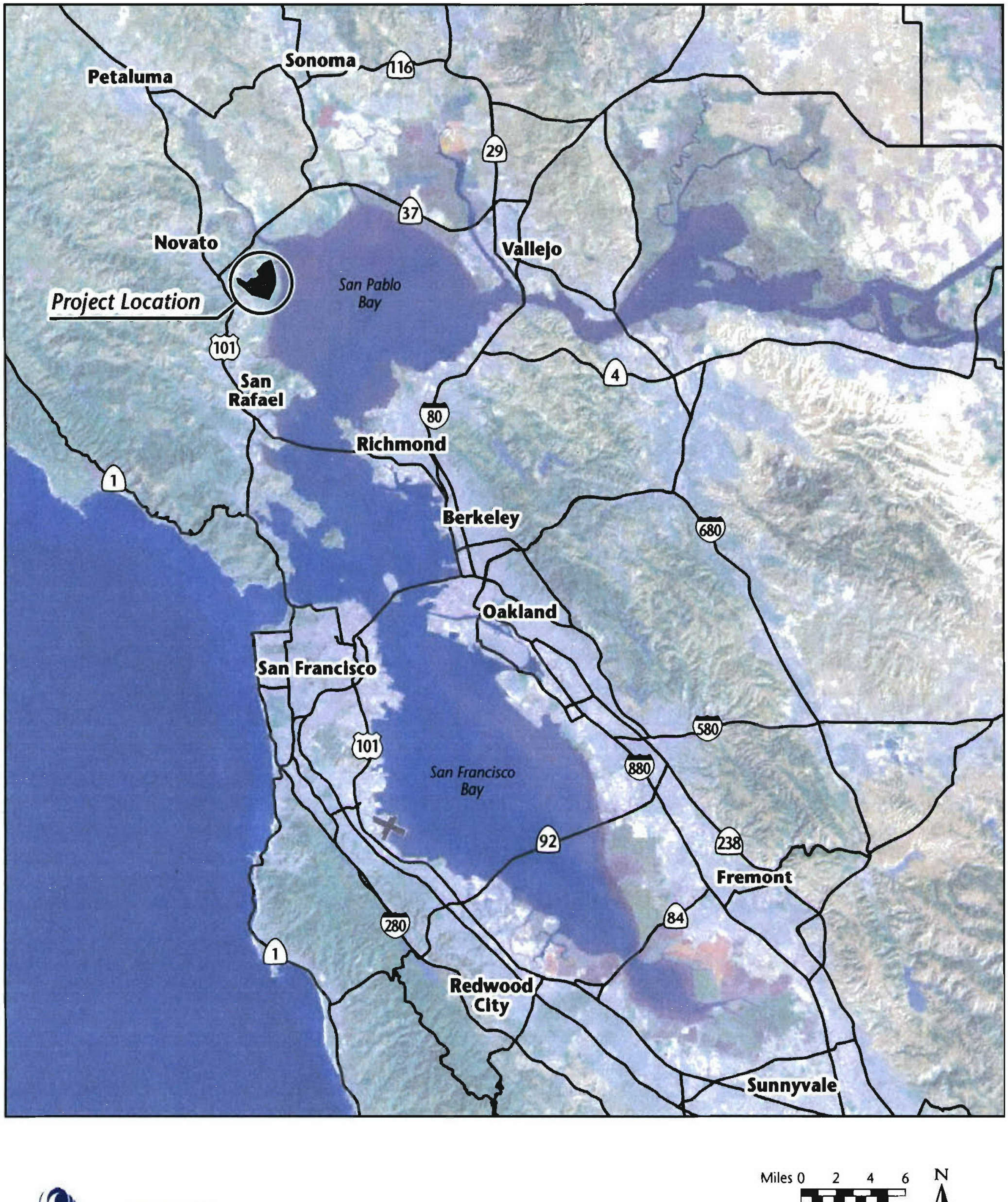
2.3.1 Real Estate Parcels Considered

The BMKV parcel lies on the northern border of the airfield and to the west and north of the SLC parcel. This parcel was historical tidal marsh. The property has recently been in agricultural use (hay production). The former property owners intended to develop this parcel as a residential community and golf course. However, the non-federal sponsor has recently acquired this parcel and it is available for restoration. An additional parcel, a portion of the area commonly referred to as the 'bulge' area will be required as an access area. The parcel is located adjacent to the west of the HWRP (HAAF panhandle area), is currently owned by the City of Novato and will be acquired by the Coastal Conservancy on a fee basis. The Access Area will accommodate a display board, parking area, and restrooms. The gross appraisal for these parcels is presented in Appendix F in the Real Estate Plan.

2.3.2 Land Use

The BMKV site consists of former baylands that were diked for agricultural use in the late 19th century. In the mid-1800s, the shoreline was located just east of the BMK residential area. The area west of the shoreline was tidal marsh and salt pond, including the location of the BMK community, the western side of BMKV and Pacheco Pond. In the mid to late 1800s, hydraulic mining resulted in accretion of sediment along the shoreline. In the recent past, the majority of the BMKV site has been under cultivation for oat hay, with the exception of two fields where placement of dredged material was authorized in the 1980s, and which have subsequently been left fallow. The northern and western portions of the site support actively farmed hayfields with sparse to moderately dense inclusions of low-quality seasonal wetland habitat. This area also supports fallow croplands with sparse inclusions of alkali/saline meadow and moderately dense inclusions of low-quality seasonal wetland. The southeastern corner of the site is ruderal herbaceous upland that appears to have been farmed in the past and now supports sparse inclusions of alkali/saline meadow and moderately dense inclusions of low-quality seasonal wetland. Seasonal wetland inclusions are dominated by nonnative species and locally support minimal vegetative cover. The east margin of the BMKV site, outboard of the levee along San Pablo Bay, supports tidal marsh habitat. Pickleweed occupies high marsh areas, while cordgrass occurs in the low marsh along slough channel banks and adjacent to the Bay. A similar habitat distribution characterizes the northern margin of the site along Novato Creek.

An analysis of the potential extent of jurisdictional waters of the United States on the BMKV site was conducted in 1997 by LSA Associates. The site supports 1,360 acres of agricultural lands (hayfields) and 250 acres of nonagricultural lands (levees, ditches, and uncultivated land).

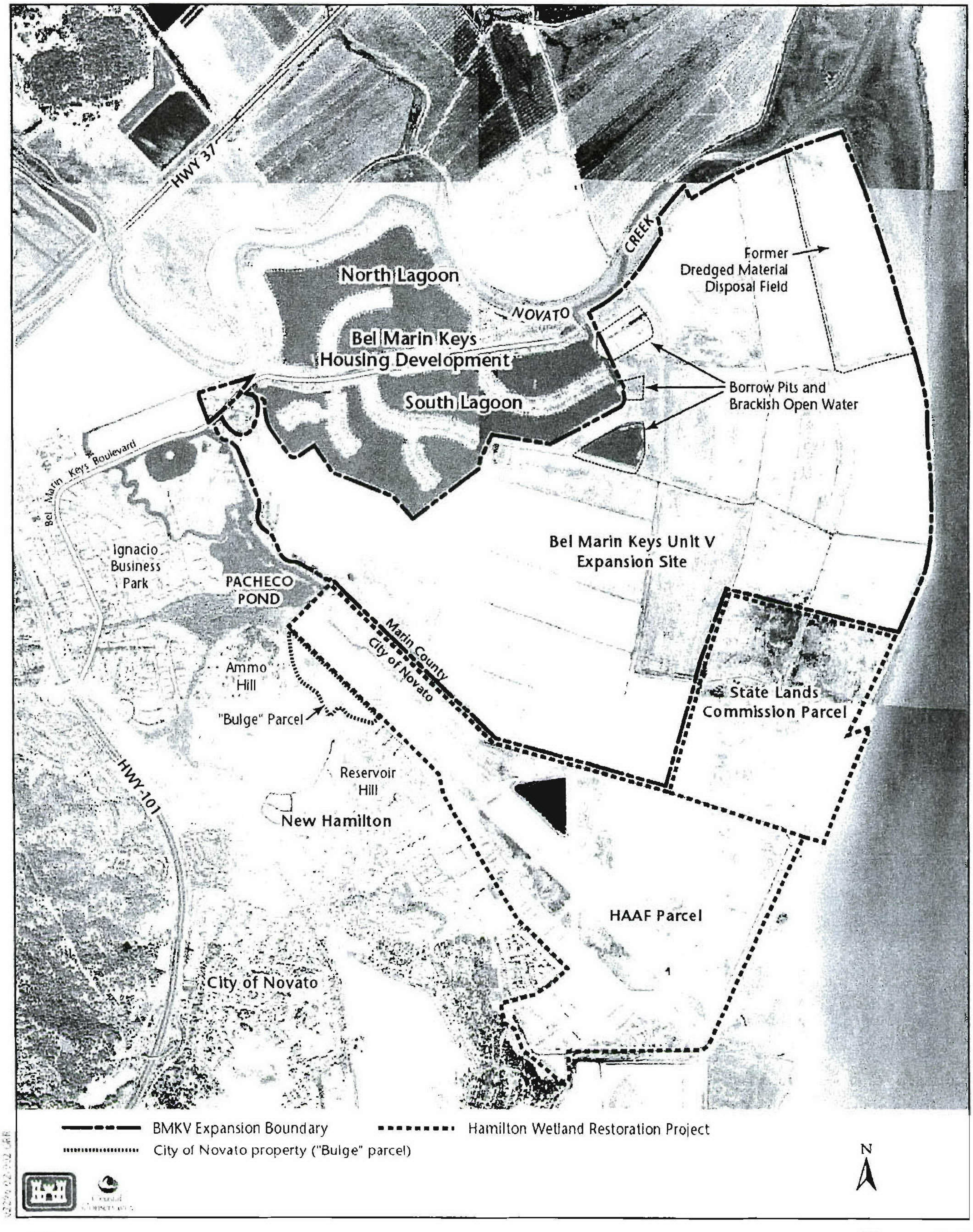


Coastal Conservancy

Jones & Stokes

nhc northwest hydraulic consultants

Figure 2-1
Location of the Bel Marin Keys Unit V Expansion Site



Jones & Stokes

nhc northwest hydraulic consultants

Figure 2-2
Bel Marin Keys Unit V Expansion Site

LSA's 1997 analysis concluded that a total of 369 acres of jurisdictional wetlands occur on the site, including 151 acres within agricultural lands, and 218 acres in nonagricultural lands.

The habitats present at the BMKV site include aquatic, wetland, and grassland communities and developed areas. A small riparian area (Pacheco Pond) is present in the western portion of the property. A substantial portion of the project site is agricultural land. These habitats and the plant and wildlife species associated with the BMKV site are described below. Habitat types and acreages are derived from the results of previous habitat inventories of the project area.

Aquatic Communities
Aquatic communities found in the expansion area include subtidal aquatic (i.e., aquatic habitats that are never exposed during low tide), intertidal aquatic (i.e., emergent marsh habitat and mudflats that are exposed during low tides), and brackish open water habitats. Each of these is described below.

Subtidal Aquatic Habitat
Subtidal aquatic habitats are areas of continuous open water that are submerged during even the lowest tide; as a result, these areas are too deep to support the types of vegetation found in emergent (i.e., occasionally exposed) marsh habitat. Phytoplankton, zooplankton, and fish, such as longfin smelt, northern anchovy, speckled sanddab, and staghorn sculpin, occupy subtidal aquatic habitat. Benthic (bottom-feeding) organisms, such as worms and clams, can be found in the sandy, muddy bottom. Many species of waterfowl and diving birds use subtidal aquatic habitat for feeding areas.

Intertidal Aquatic Habitat
Intertidal aquatic habitat comprises two subtypes of habitat, intertidal mudflats and coastal salt marsh. Emergent coastal salt marsh is discussed in detail as part of the Wetlands Communities description, below. Intertidal mudflats are made up of unconsolidated, muddy bottom areas without vegetation and are present along the coastal salt marshes that are outboard of the perimeter levee. Mudflats are exposed twice daily during low tide and extend to the extreme low water elevation. Narrow bands of mudflat are also found at the same elevations along the margins of subtidal channels in tidal marshes. Mudflats are highly productive and support large populations of benthic organisms, including aquatic worms, crustaceans, and mollusks that are important elements of the estuarine food web. When exposed or covered by shallow water, mudflats provide important foraging areas for migrant and wintering shorebirds, wading birds, and gulls.

Brackish Open Water Habitat
Brackish open water habitat occurs on approximately 52 acres of the BMKV site and includes one of the borrow pits and the drainage ditches. Borrow Pit A is 10-15 feet deep, intersects the water table year-round, and is perennially inundated in all but drought years (LSA Associates 1997). Open water in the borrow pit ponds is used by water birds during migration and provides foraging areas for resident waterfowl (Environmental Science Associates 1993). The approximate size of Borrow Pit A is 15 acres.

Drainage ditch banks and channels also provide foraging habitat and cover for some species, such as herons, egrets, and dabbling ducks, and movement corridors for striped skunks, raccoons, and other species. The area of the drainage ditches is approximately 36 acres and includes small amounts of brackish marsh vegetation along the edges of the ditches.

Wetland Communities

The expansion area contains four types of non-agricultural wetland communities: coastal salt marsh (tidal), coastal salt marsh (nontidal), small amounts of brackish marsh in the drainage ditches, and seasonal wetland. In addition, seasonal ponding occurs within the cultivated fields, though it varies in magnitude from year to year. Delineation of jurisdictional wetlands has been completed for the BMKV parcel (LSA Associates 1997) and has been verified by the Corps and the Natural Resources Conservation Service (NRCS). All of the non-agricultural wetland types, except brackish open water, are considered jurisdictional wetlands by the Corps in accordance with the Clean Water Act. Approximately 151 acres of cultivated fields have also been delineated as jurisdictional agricultural wetlands based on determination of a statistically derived average ponding area, in addition to vegetation and soils criteria (LSA Associates 1997).

Coastal Salt Marsh (Tidal)

Coastal salt marsh under tidal influence occurs in two locations in the expansion area: between the levee at the eastern end of the expansion area and the open water of San Pablo Bay, and between the northern levee and Novato Creek. Approximately 20 acres of salt marsh habitat occurs within the BMKV site, but more substantial areas are located outside the site. This habitat can be divided into three distinct zones based on the frequency and duration of tidal inundation. These zones are described below.

- Low marsh habitat occupies the elevations between mean tide level and mean high water and, as such, is inundated daily. In the expansion area, low marsh is adjacent to the open waters of San Pablo Bay and Novato Creek and is dominated by California cordgrass.

- Middle marsh habitat occupies the elevations between mean high water and mean higher high water. It is predominant outboard of the perimeter levee and is inundated frequently throughout each month, although for shorter periods than low marsh. Middle marsh is dominated by common pickleweed.

- High transitional-marsh habitat occupies the elevations between mean higher high water and the highest tide level. This habitat is inundated infrequently and for short periods. A narrow strip along the bayside of the levee supports high marsh and plant species that are tolerant of saline conditions but not adapted to frequent, long-term inundation, including saltgrass, alkali heath, fat-hen saltplant, and gumplant.

The tidal coastal salt marsh community provides food, cover, and breeding habitat for many wetland-dependent wildlife species. The dense vegetation and large invertebrate populations typically associated with salt marshes provide ideal foraging conditions for a variety of bird species, including rails, egrets, herons, waterfowl, and shorebirds. Emergent marsh habitat also provides nesting, foraging, and escape cover for various songbirds and wading birds. The

vegetation in the marsh habitat is used as direct cover and sources of food by rearing juvenile and adult fish, such as longfin smelt, chinook salmon, and steelhead. Emergent marsh habitat is within the tidal zone and drains frequently; it is therefore not used for spawning. Benthic organisms use this habitat in the same way they use intertidal mudflats.

In addition to being important habitat for wetland-associated wildlife, the salt marsh community is also an important component of the San Pablo Bay ecosystem, providing nutrients and organic matter to the mudflats and open water of the Bay. These, in turn, are important habitats for a variety of waterfowl, shorebirds, and other water birds. Wildlife species observed at the proposed wetland restoration site during field surveys conducted in 2001 and 2002 include Double-Crested Cormorant, Great Blue Heron, Great Egret, American Coot, Killdeer, Northern Harrier, Salt Marsh Common Yellowthroat and San Pablo Song Sparrow (May & Associates 2001; Jones & Stokes files 2002). Other species expected to use tidal coastal salt marsh include the raccoon, Mallard, Sora, Virginia Rail, and Willet.

Coastal Salt Marsh (Nontidal)
Small areas of coastal salt marsh vegetation that are not inundated by tides (approximately 21 acres total) are located along the interior slopes and base of levees along Novato Creek and San Pablo Bay and in two of the borrow pits. Dominant species include pickleweed, saltgrass, brass buttons, ryegrass, and coyote brush. These habitat areas may provide important refuge for wildlife associated with tidal salt marsh during periods of extreme high tides (Environmental Science Associates 1993).

Brackish Marsh
Small amounts of brackish marsh vegetation are present along the edge of the drainage ditches in the BMKV parcel, as discussed above. Dominant emergent wetland plants along drainage ditches are alkali bulrush and cattail. Because marsh vegetation associated with ditches occurs in narrow linear bands, these habitat areas typically support a lower diversity of wildlife than larger, more contiguous units of brackish marsh. The area of the brackish marsh vegetation has not been estimated.

Seasonal Wetlands
Areas of seasonal wetland (approximately 114 acres total) are present in the field at the west end of the site, adjacent to the borrow pits, and in the dredged material disposal field. Plant species that may dominate in seasonal wetland habitat are saltgrass, alkali heath, salt marsh bulrush, fat-hen saltplant, western goldenrod, sheep sorrel, 6-weeks fescue, tall fescue, sedge, rush, and creeping wild rye (Environmental Science Associates 1993).

Seasonal wetlands potentially provide high-tide refugia for California Clapper Rail, California Black Rail, and other species that use tidal coastal salt marshes; seasonal foraging and resting habitat for migratory shorebirds, waterfowl, and other water birds; and foraging habitat for raptors, herons, egrets, blackbirds, raccoons, striped skunks, and aquatic garter snakes (Environmental Science Associates 1993).

Agricultural Wetlands
During winter, some of the agricultural fields become saturated or seasonally flooded with runoff from precipitation. Flooded fields provide foraging and resting habitat for a wide diversity of wintering and migrant shorebirds, waterfowl, and other water birds during winter. Based on a statistically derived average ponding area, approximately 151 acres of agricultural wetlands have been delineated on the BMKV site (LSA Associates 1997). Because ponding amounts can vary in location and size by year, these areas have not been mapped.

Grassland Communities
Grassland communities in the project area include annual grassland vegetation as well as agricultural lands.

Annual Grassland
Annual grassland vegetation in the expansion area (approximately 129 acres total) is ruderal (i.e., grows in disturbed areas) and is dominated by weedy, non-native annual grasses and forbs, such as ripgut brome, wild oats, Mediterranean barley, perennial ryegrass, yellow star-thistle, curly dock, bristly ox-tongue, and black mustard. Scattered shrubs and non-native trees, such as coyote brush, blackberry, and eucalyptus, are also present in some grassland areas (Environmental Science Associates 1993).

Annual grassland provides important habitat for various wildlife species. Representative wildlife species observed using grasslands at the expansion site are the Turkey Vulture, White-Tailed Kite, Northern Harrier, Red-Tailed Hawk, Golden Eagle, American Kestrel, Short-Eared Owl, Savannah Sparrow, Western Meadowlark, and Brewer's Blackbird (May & Associates 2001; Jones & Stokes files).

Agricultural Lands
Most of the proposed wetland restoration site (approximately 1,241 acres) is composed of agricultural fields that are planted and harvested annually. Approximately 75% of these lands are managed for oat hay production. Following the harvest, fields remain fallow until the following planting season. When fallow, the fields typically support non-native invasive plants such as star thistle (Environmental Science Associates 1993). Cultivated fields, particularly when fallow, provide habitat values similar to grasslands and provide habitat for raptors, songbirds, and small mammals. As noted above, approximately 151 acres of the agricultural land has been delineated as agricultural wetlands.

Riparian Habitat (Pacheco Pond and Vicinity)
Pacheco Pond is heavily used both in winter and summer by a variety of water birds, including waterfowl, grebes, loons, cormorants, rails, pelicans, coots, moorhens, terns, gulls, herons, egrets, shorebirds, and blackbirds. A number of species breed in the surrounding area due to the presence of a surrounding cattail marsh that provides food and cover. The pond itself also reportedly supports a number of fish species, including striped bass, smelt, and bullhead.

The confluence of Pacheco Creek and Arroyo San Jose creates a riparian area on the western side of Pacheco Pond that supports willows, non-native berries, and other freshwater riparian species.

Saltmarsh Common Yellowthroat has previously been observed in the wetland/riparian area north and east of Ammo Hill (U.S. Army 1996). Northwestern pond turtle has been found in or near this area (Lewis 2002). Chinook salmon have also been reported spawning in Arroyo San Jose Creek above Highway 101, upstream of Pacheco Pond (Lewis 2002). A red-legged frog survey has been conducted in or near the confluence area, but no frogs were located (Lewis 2002). Based on aerial photography, much of the area of a potential alignment near the confluence appears likely to be wetland. It is probable that the area between the northern end of the Marin County Flood Control access road and Bel Marin Keys Boulevard is also wetland.

Developed Areas
Human-made structures present within the expansion area include drainage pump stations, small out buildings, and utility infrastructures. Compared to vegetated habitats, these developed areas support a low diversity of wildlife. Species commonly associated with developed areas include the Barn Swallow, Northern Mockingbird, American Crow, and European Starling.

2.3.3 Special-Status Species

Fourteen special-status plant species have potential to occur on or near the BMKV parcel; however, surveys indicate that they are not present on the BMKV parcel. No special-status plant species have previously been reported from the expansion area (Natural Diversity Data Base 1997). Potentially suitable habitat is present in the expansion area for only three of those species: soft bird's-beak, Point Reyes bird's-beak, and Marin knotweed (Environmental Science Associates 1993). This potential habitat is associated with the transitional zone at the upper margins of coastal salt marshes. These species were not found during rare plant surveys conducted in 1980, 1985, 1988, 1991, and 2001 (Environmental Science Associates 1993, May & Associates 2001). Therefore, the SEIS/R assumed that special-status plant species are not present in the expansion area and will not be affected by the proposed BMKV expansion.

Seventeen special-status fish and wildlife species are known to occur or are assumed to use suitable habitat within diked portions of the expansion area or in marshes and aquatic habitats bayside of the perimeter levees. These species are listed below.

- Longfin smelt
- Steelhead (Central Valley and Central California Coast ESUs)
- Chinook salmon (Sacramento River Winter-run, Central Valley Spring-run, and Central Valley Full-run ESUs)
- Coho salmon (Central California Coast ESU)
- Double-Crested Cormorant
- California Brown Pelican
- White-Tailed Kite
- Northern Harrier
- Golden Eagle
- Peregrine Falcon
- California Clapper Rail
- California Black Rail
- Short-Eared Owl

- Burrowing Owl
- Saltmarsh Common Yellowthroat
- San Pablo Song Sparrow
- Salt marsh harvest mouse

A complete list of potential special-status species is contained in the 2002 Supplemental EIS/R attached to this GRR. No trapping has been conducted to determine the presence of the salt marsh harvest mouse; however, as for the previous feasibility study for the HWRP, this study assumes that the mouse is present in the existing pickleweed marsh.

2.3.4 Hazardous, Toxic, and Radiological Wastes (HTRW)

Areas of potential concern on the BMKV site include a former Aboveground Storage Tank (AST) area, the west barn, the east barn, the crop duster and drainage ditches, and a debris pile. Total Petroleum Hydrocarbon as diesel (TPH-d), 4,4-DDE, 4,4-DDD, 4,4-DDT, dioxin, and metals (arsenic, barium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, zinc) have been detected in shallow soil samples. A Phase I Preliminary Environmental Site Assessment was completed in May 2000, before the SCC purchased the property. The results of follow-up sampling was presented in "Results of Shallow Soil Investigations" by Erler and Kalinowski in March 2002. These documents are attached to this GRR as Appendix B. Any remediation required for the Access area to be located on a portion of the 'bulge' parcel is the responsibility of the SCC. The SCC has coordinated with the Department of Toxic Substances Control (DTSC), and does not expect HTRW remediation to delay the expansion of HWRP to BMKV.

2.3.5 Regional Hydrology

The San Francisco Bay estuary is one of the largest and most significant estuaries along the western coast of the United States. Over 40% of California's land area and 60% of the volume of the state's runoff drains into the estuary (EPA et al., 1996). The HWRP, including the BMKV parcel, is located along the northwestern shore of San Pablo Bay, in the northern reach of the estuary.

San Pablo Bay is a large, shallow estuary. Typical water depths in San Pablo Bay are 6 feet at low water. A naturally deeper, periodically dredged, navigational channel maintained at -35 feet mean lower low water (MLLW) extends through the Bay between Point San Pedro and the Carquinez Strait. A 3,500-foot-wide expanse of mudflat in San Pablo Bay, adjacent to the project site, is exposed at low tide.

San Pablo Bay is subject to semidiurnal tides with a 6-foot range. Tidal characteristics for San Pablo Bay at the mouth of the Petaluma River north of BMKV are presented in Table 2-1. Monthly variation in tidal fluctuations (not shown in Table 2-1) create cycles of extreme high and low tides, called spring tides, and less pronounced tides, called neap tides. The values in Table 2-1 are for current mean sea level elevations for San Francisco Bay. Mean sea level is expected to rise by 1 foot per 100 years as a result of global warming trends (IPCC, 1996). The

100-year tide is based on an estimate of 6.5 feet National Geodetic Vertical Datum (NGVD) by the USACE (1984). Phillip Williams and Associates, Ltd. (PWA) adjusted this value upward to 7 feet to account for the effects of a number of factors including mean sea level rise; wind-induced set-up within San Pablo Bay; wave run-up on the adjacent mudflat; flood runoff from the Sacramento-San Joaquin Delta; and uncertainties in the USACE's estimation methods (Knuuti, 1995).

Regional drainage features include Pacheco Creek, Arroyo San Jose, and Novato Creek. Pacheco Creek traverses the southwestern side of the HWRP and BMKV area. Pacheco Creek drains into Pacheco Pond, located adjacent to HWRP's northwestern boundary. Arroyo San Jose, a slightly larger stream draining a 5.4-square-mile area, also drains into Pacheco Pond, but does not cross base property. Pacheco Pond provides temporary storage prior to draining through flap-gates to Novato Creek, which is fully tidal at its confluence with the Pacheco Pond outflow.

Surface water runoff from the areas west of the project site is carried by Pacheco Creek and Arroyo San Jose. Historically, these streams were part of a network of natural channels that drained through the low-lying area, where Pacheco Pond (also known as Ignacio Reservoir) is now located, to Novato Creek. Pacheco Creek and Arroyo San Jose both have their headwaters on Big Rock Ridge, at elevations of 1,300–1,600 feet NGVD. Pacheco Creek has a watershed area of 1.9 square miles and Arroyo San Jose has a watershed area of 5.4 square miles. Pacheco Pond drains to Novato Creek through a leveed channel with a flap gate outlet (Bissell & Karn/Greiner 1993 and unpublished Corps data).

Although Pacheco Creek, Arroyo San Jose, Novato Creek, and Pacheco Pond are not connected to the HWRP and BMKV site drainage during average runoff conditions, they become important sources of flow to the site during flood conditions. This issue is discussed further in the following local hydrology section.

Table 2-1 Tidal Characteristics at Bel Marin Keys and Hamilton Wetland Restoration Project (based on Petaluma River Entrance Tide Gauge #941-5252)

	NGVD Datum (feet)	**MLLW Datum (feet)**
100-year high tide	7.00*	9.63
10-year high tide	6.00	8.63
Mean highest annual tide	4.68	7.31
Mean Higher High Water (MHHW)	3.43	6.06
Mean High Water (MHW)	2.86	5.49
Mean Tide Level (MTL)	0.61	3.24
Mean Low Water (MLW)	-1.63	1.00
Mean Lower Low Water (MLLW)	-2.63	0.00

*The 100-year tide is based on an estimate of 6.5' NGVD by USACE (1984). For design purposes, this has been adjusted upward to 7.0 feet to account for the effects for a number of factors: mean sea level rise; wind-induced set-up within San Pablo Bay; wave runup on the adjacent mudflat; flood runoff from the Sacramento-San Joaquin Delta; and uncertainties in the estimation methods. (HWRP Feasibility Report, U.S. Army Corps of Engineers, 1998)

Note: NGVD is mean sea level of 1929.

Sources: USACE SFD (1984), Tides and Currents tide prediction software, National Oceanic and Atmospheric Administration (NOAA) tidal benchmark data (1998), NOAA NCDC database EarthInfo, 1997, on CDROM, Hamilton ADB Station, period of record 1948-1964.

2.3.5.1 Local Hydrology

The HAAF, SLC, and BMKV parcels are all served by local drainage facilities, including drains, channels, culverts, and pump stations with outfalls into San Pablo Bay. Ground elevations in these areas are generally from 0 to -4 feet NGVD, several feet below the mean higher high water (MHHW) elevation of 3.4 feet. Major drainage features and hydrologic resources in the project area are described briefly below.

Pacheco Creek

Pacheco Creek originates on Big Rock Ridge three miles west of HWRP and BMKV at an elevation of 1,300 feet and drains a watershed of approximately 1.9 square miles. The creek crosses U.S. Highway 101 near the Alameda del Prado/Nave Drive, and crosses Nave Drive, Marin Valley Road, Bolling Drive, Main Entrance Road, and State Access Road in a series of culverts. The 10-year and 100-year peak discharges for Pacheco Creek were computed in 1993 by Bissell & Karn/Greiner to be 470 and 770 cubic feet per second (cfs), respectively. In 1998, Phillip Williams and Associates calculated them to be 582 cfs and 1,041 cfs, respectively.

The lower reach of Pacheco Creek is defined as the region downstream of the Northwest Pacific Railroad Bridge crossing. In this reach, overtopping due to downstream backwater effects is known to occur for flows smaller than the 10-year event (California State Coastal Conservancy, U.S. Army Corps of Engineers and Phillip Williams and Associates, 1998). When flooding

occurs, overflow was formerly directed toward Landfill 26 and back to Pacheco Pond over the Ammo Hill saddle. However, the Army has recently completed a berm to prevent such flows east of Landfill 26.

Arroyo San Jose

Arroyo San Jose also originates on Big Rock Ridge, five miles west of the HAAF and BMKV parcels at an elevation of 1,600 feet and drains a watershed of approximately 5.4 square miles. The creek crosses U.S. Highway 101 near the Ignacio Boulevard/Bel Marin Keys Boulevard interchange and discharges into Pacheco Pond. In 1993, Bissell & Karn/Greiner computed the 10-year and 100-year peak discharges to be 1,200 and 2,300 cfs, respectively. In 1998, Philip Williams and Associates (PWA) calculated the 10-year and 100-year discharges to be 1,369 and 2,455 cfs, respectively. Arroyo San Jose accounts for approximately 75% of the inflow to Pacheco Pond (PWA, 1998). Arroyo San Jose is expected to remain within its banks during floods as large as the 100-year event, with the exception of the lower reaches where high stages in Pacheco Pond can cause overtopping due to backwater effects.

Pacheco Pond

Both Pacheco Creek and Arroyo San Jose discharge into Pacheco Pond (also called Ignacio Reservoir). This reservoir was built by the developer of Ignacio Business Park and deeded to Marin County Flood Control and Water Conservation District (MCFCWCD) as a detention basin for flows from Pacheco Creek and Arroyo San Jose. It also provides freshwater wetland and wildlife habitat, and is operated jointly by MCFCWCD and the California Department of Fish and Game. The pond occupies 120 acres and has a storage capacity of approximately 866 acre-feet at an elevation of approximately 7 feet NGVD. (Appendix E, NHC Memo) The pond discharges to Novato Creek through a leveed channel with an invert elevation of -.86 feet NGVD, controlled by six 4-foot by 4-foot flap gates. (PWA, 1998) The outlet is located at the Bel Marin Keys Boulevard bridge. High tides in San Pablo Bay prevent outflow from Pacheco Pond and may cause flow reversal in the outlet channel if the flap gates do not operate properly (Bissell & Karn/Greiner 1993). Ground elevations near the reservoir are near mean sea level.

Water surface elevations in Pacheco Pond can be controlled by a sill at the upstream face of the Bel Marin Keys Boulevard culvert. The minimum pond elevation can be raised by inserting flashboards on the upstream side of the culvert. An operating agreement between MCFCWCD and Department of Fish and Game (DFG) establishes the desired water-surface elevation in the pond water at 1.5 feet above NGVD. The minimum pond water surface elevation is equivalent to the sill elevation of the culvert (approximately -.86 feet NGVD). The reservoir is also operated to provide freshwater wetland and wildlife habitat.

During high-flow events, the water level in Pacheco Pond may exceed the elevation of adjacent levees. The lowest point in the levees (elevation 5.6 feet NGVD) is north of the pond, in the outlet channel, adjacent to the Leveroni property. Overtopping has also been observed on the west side of the pond near Ignacio Business Park and near the confluence of the outflow channel with Novato Creek.

Novato Creek
Novato Creek is the principal drainage in the vicinity of the expansion site and has an approximate total watershed area of 44 square miles. The Corps has computed 10- and 100-year discharges near the Highway 101 crossing to be 3,420 and 6,230 cfs, respectively, and recognizes an "ultimate flow" of 8,000 cfs at the mouth of Novato Creek. However, the railroad bridges downstream of Highway 101 and adjacent to Highway 37 constrict flow, causing overtopping upstream of the lowest reach of Novato Creek and reducing the actual discharge in the lower reaches of the creek. The 8,000 cfs value in particular is unlikely to pertain to the reaches of Novato Creek adjacent to the BMKV site (CSW/Stuber-Stroeh Engineering Group 1996).

Recent modeling efforts have shown that the tidal influence extends upstream of Highway 101 to the City of Novato during flows greater than the 10-year event (PWA 1998). The maximum water surface elevation observed at the Highway 37 crossing was approximately 7 feet NGVD (PWA 1998).

Top-of-levee surveys completed in 1996 indicate that the levee crest between Novato Creek and the BMKV site dips to an elevation of approximately 5.6 feet NGVD, at a point approximately 1,000 feet downstream from the BMKV south lagoon navigation lock (Jones and Stokes 1996). Overtopping of this levee was observed by BMK residents in the February 1998 flood event.

Bel Marin Keys Residential Development
The BMK residential development is located adjacent to the northwest boundary of the expansion site. BMK is a waterfront residential community with 2 internal constructed lagoons that offer access to Novato Creek through a system of locks. The BMK community uses Novato Creek for boat access to San Pablo Bay and relies on tidal changes in water level to periodically exchange flow between the BMK lagoons and San Pablo Bay. The community is susceptible to flooding during extreme high tide stages. Storm drainage to the lagoons is aggravated by coincident high Novato Creek stages, caused either by high San Pablo Bay tides or high Novato Creek discharge, with high amounts of local precipitation over the BMK development.Water level is managed at 2 feet NGVD in the north lagoon and 0.5-1 foot NGVD in the south lagoon (CSW/Stuber-Stroeh Engineering 1996). Stormwater is discharged to Novato Creek via the boat access lock. Stormwater from the south lagoon can also be discharged onto BMKV via a weir in the levee on the eastern edge of the south lagoon. Discharge into Novato Creek is limited by stage in the creek; during high-flow periods, runoff is impounded in the lagoons until flow recedes (CSW/Stuber-Stroeh Engineering 1996).In 1997, the former owner of the BMKV property granted the BMK Community Services District (CSD) the right to construct, maintain, and repair an emergency spillway on the existing levee, the purpose of which is to relieve high water in the lagoon surrounding Units III and IV of the BMK subdivision. This agreement also granted the right to discharge water from the lagoon onto a 3-acre portion of the BMKV property when the lagoon and Novato Creek reach a level of 1.5 NGVD.

Bel Marin Keys Drainage
The BMKV parcel is currently in agricultural use and is drained by a system of channels. Under normal runoff conditions, most of the runoff from the parcel drains to a pump station at the northeast corner of the property that discharges to San Pablo Bay. One hundred acres drain to the channel system on the SLC parcel to the east, and these flows are conveyed by gravity to the HWRP perimeter ditch system through two 24-inch culverts. During flood conditions, drainage may flow into or from the BMKV site through a levee gap in the northwest corner of HAAF and/or a levee gap between HAAF and the SLC parcel, as described in the following two sections.

Hamilton Army Airfield Drainage
Drainage from the HAAF parcel is collected in a perimeter ditch system and conveyed to three pump stations on the margin of San Pablo Bay. The drainage system is described in detail in an engineering evaluation of the ditch system prepared by International Technology Corporation for the Corps (U.S. Army Corps of Engineers 1997). Drainage subareas for the HAAF parcel are delineated in the Flood and Drainage Baseline Study.

The perimeter ditch system is served by three pump stations on the margin of San Pablo Bay: Buildings 35, 39, and 41. These pump stations have a combined capacity of 230 cfs and are equipped with both diesel-powered and electric motor-driven pumps (unpublished Corps data).

In addition to the HAAF parcel, the perimeter ditch system receives drainage from several adjacent areas:

- drainage flows through a 42-inch gated culvert through the perimeter levee near the southwest corner of HAAF on the St. Vincent's property, which carries flows from the western portion of the former Department of Defense (DOD) housing and Long Point peninsula upland areas adjacent to the airfield, and from a portion of the St. Vincent's property;

- drainage from the New Hamilton Partnership development, the eastern portion of the former DOD housing area, and other areas adjacent to the west side of the airfield that are conveyed to the ditch in two outfalls, one near Reservoir Hill (west outfall) and one near the southwest corner of the airfield (east outfall);

- drainage from the area of Landfill 26 and Ammo Hill that is conveyed to the ditch system through a 48-inch flap-gated culvert;

- flood overflow (under some conditions) from Ignacio Reservoir and the BMKV parcel through a levee gap 2,000 feet southeast of the northwest corner of the HAAF parcel;

- flood overflow and normal drainage through two 24-inch gated culverts on the SLC parcel.

- In addition, flood overflow from Pacheco Pond could be conveyed from Pacheco Pond to HAAF through the two 24-inch siphons (these siphons are currently not operational).

California State Lands Commission (SLC) Parcel
The SLC parcel presently drains to the HAAF perimeter ditch system through a network of channels on the SLC parcel. Flows in the channel system are conveyed to the HAAF perimeter ditch system near the Novato Sanitary District (NSD) dechlorination facility in two 24-inch pipes. The HAAF perimeter ditch system conveys these flows to HAAF pump stations that discharge to San Pablo Bay. Under extreme flow conditions, water may overtop the low levee between SLC and HAAF.

2.3.6 Geotechnical Conditions

The area of the proposed wetland restoration is presently below sea level and is protected from tidal inundation by flood control levees along San Pablo Bay and a system of drainage trenches and pumps. The water table is typically located several feet below the surface, and is seasonally variable. The area is underlain, below a thin near-surface "crust", by soft marine clays known as Bay Mud. The crust is composed of desiccated Bay Mud over the entire area. Bay Mud is a plastic silty clay, with high compressibility, low shear strength, and generally low permeability. Bay Mud is underlain by much stronger and less compressible, competent soils. Due primarily to its high compressibility and low strength, the soft Bay Mud poses considerable challenges to development of the site as a wetland. New fill loads (i.e., any dredged sediment imported to raise grades at the project area) placed on top of areas underlain with Bay Mud cause compression of the mud, which in turn requires more fill to be placed. This compression also causes uneven settlement of the surface. Depending on the depth of the soft Bay Mud, the settlement may take from 10 to as much as 50 years to develop.

Fills applied over limited areas, such as levee fills, cause shear stresses in the Bay Mud that will cause stability failures if they exceed the soil's shear strength. Therefore, new levees need to be designed with geometries that provide adequate stability; this may require stabilizing berms. Please refer to the Geotechnical Appendix for a detailed description.

2.3.7 Observed Sedimentation Rates

Observed sedimentation rates adjacent to San Pablo Bay at Port Sonoma Marina, Bel Marin Keys, and the Petaluma Marsh range from 0.5 to 1.3 feet/year, and suggest an average initial rate of one foot per year. These estimates are based on measurements of bed elevation changes in these maintenance dredging and wetland restoration sites. However, the observed sedimentation rates are representative of subtidal or subsided systems. As the site fills and becomes intertidal, water depths, inundation periods, tidal exchange, and sedimentation rates will decrease exponentially. Therefore, the one foot per year rate should be considered representative of the initial phases of evolution in subsided San Pablo Bay systems. A more detailed discussion of spatial and temporal effects on sedimentation rate is provided in Appendix E, Hydrology and Hydraulics Analysis.

2.3.8 Future Conditions Without a Project

Under the No-Action Alternative of this GRR (without project condition), the Hamilton Wetland Restoration Project would proceed as authorized, without BMKV, and with potential delays to implement the SLC component (314 acres), the Navy Ballfields (18 acres) and the seasonal wetland portion of HAAF due to uncertainties related to HTRW remediation. If the HWRP is not reauthorized to include BMKV, the SCC would continue to use the site for agricultural production for a few years. Following agricultural use, the site would remain inactive; the SCC would implement a maintenance program to control weeds and retain the integrity of fencing. The perimeter levees would not be breached and natural sedimentation would not occur. If the project site continues to be used in this manner, ground-surface settlement would likely continue to occur at its existing rate. Substantial alteration of natural topography and loss of soil resources capable of supporting sensitive wetland habitats would likely occur. The without project condition assumes that navigation projects will utilize the disposal sites designated under the LTMS implementation plan, as provided in Article II.F. of the HWRP PCA. Please see Appendix A for a detailed description.

2.4 PROBLEMS AND OPPORTUNITIES

2.4.1 Problems

2.4.1.1 <u>Historical Decline of Wetlands</u>

The historical decline of wetlands is a significant problem; this project is being proposed to restore important tidal salt marsh habitat to San Francisco Bay. Diking or filling them for purposes such as agriculture, housing, and salt production has destroyed approximately 90% of the original tidal wetlands of San Francisco Bay. This loss of tidal wetlands has greatly reduced the amount of habitat available to many species of fish and wildlife. Several local animal and plant species, including the salt marsh harvest mouse and the California clapper rail, have been listed as endangered due to the reduction of their wetland habitats.

2.4.2 Opportunities

2.4.2.1 <u>Possible Delay of Hamilton Army Airfield and State Lands Commission Parcels</u>

In expanding HWRP to include BMKV, there is an opportunity to ensure that available dredged material is beneficially reused, regardless of possible delays at the currently authorized HWRP. Due to the unpredictability of HTRW remediation, the HAAF and SLC parcels may not be available to receive material from the Oakland 50-foot project in 2005 and 2006. If the HWRP is expanded to include the BMKV parcel, portions of BMKV could be prepared for dredge material placement prior to HTRW remediation of the currently authorized HWRP (HAAF and SLC parcels), and dredge material could be placed on the BMKV portion while HTRW remediation is completed. If HWRP is not expanded to include BMKV, dredge material that would have been beneficially used may be lost to ocean disposal.

2.4.2.2 Increased Habitat Quality and Quantity
There is an opportunity to expand and enhance habitat quality and quantity. A substantial increase in project benefits could be achieved by expanding the project site to include the adjoining 1,610-acre BMKV property owned by the SCC. This would expand the total project site to approximately 2,600 acres (including the additional 2-acre access area). The actual habitat benefits accrued would undoubtedly be greater even than the large proportionate increase in the project size, because larger contiguous habitats are more robust and productive than smaller, more fragmented habitats. For example, the larger resident populations of endangered species, such as the California clapper rail, will have more genetic diversity and a greater area of refuge if habitat temporarily becomes degraded or eliminated on a portion of the site. Also, potential adverse impacts to resident species from activities outside the project site, such as predation by cats and dogs from adjacent developed areas, would be buffered by the increased size of the site. Restoration of tidal wetlands on subsided diked lands provides an opportunity to offset historic habitat losses. Expanding the Hamilton site to include BMKV is expected to realize the above opportunities. The site could be restored to the tidal action of the Bay by breaching the existing bayfront levee. The expanded site would provide 2,279 acres of tidal marsh, seasonal wetlands, transitional, and upland habitat (1,395 acres on the proposed BMKV addition, 884 acres on the authorized HWRP project lands). These figures exclude subtidal, intertidal channel, open water, and tidal mudflat habitats.

2.4.2.3 Unit-Cost Savings
There is an opportunity to accrue significant unit-cost savings from the expansion of HWRP to include BMKV. Perimeter levees of the current design fronting on the BMKV property would then not need to be constructed. Levees already exist along the perimeter of the BMKV property not fronting on the project site. These levees would need to be bolstered where they protect existing developed or farmed areas. However, the length of these levees is less than that of the levees that would not be needed, and the cost of bolstering the smaller length of existing levees would likely be significantly lower than constructing the new levee proposed in the current plan. Unit costs would also likely decrease due to the economies of scale for a larger site, for example by dividing equipment mobilization and offloading facility construction costs over a larger project.

2.4.2.4 Beneficial Reuse of a Greater Quantity of Dredged Material
This project would provide the opportunity to beneficially reuse a greater quantity of dredged material and would help with implementation of LTMS goals. The currently authorized project area would accommodate up to 10.6 million cubic yards of dredged material to restore habitat areas. The BMKV site would accommodate up to an additional 13.8 million cubic yards of dredged material to restore habitat areas.

The greatly increased acreage would provide a greater and longer-term benefit to implementing the LTMS program than the currently authorized project. This would result through the increase in the capacity for beneficial reuse of dredged material from Bay projects and because the unit cost of bringing material to the site would likely be decreased through economies of scale. Use of dredged material would accelerate the rate of marsh development, making habitat available to fish, wildlife, and particularly the endangered species that depend on tidal marsh for survival. In

addition reusing the material would alleviate, to an extent, the public concern about the environmental effects of aquatic disposal. Dredged material would be available from a variety of sources. The types of sources are briefly discussed below.

Maintenance Dredging Project Sources of Dredged Material
The selected sources of maintenance dredging materials for the combined project include six Corps Operations and Maintenance (O&M) projects and seven non-Federal O&M projects. The Federal O&M projects are Oakland Harbor, Pinole Shoals, Redwood City Harbor, Richmond Harbor and Southampton Shoals (including Richmond Outer Harbor and Chevron Long Wharf) and Petaluma River Channel (across the flats). The non-Federal O&M projects include the Larkspur Ferry Channel, dredging at Chevron, Tosco and Unocal docks, and berth dredging at the Ports of Oakland, San Francisco, Richmond and Redwood City.

New Work Dredging Project Sources of Dredged Material
The Port of Oakland 50-foot Project (Federal) is authorized to provide 2.5 million cubic yards of dredged material to the HWRP, 1.8 million cubic yards of sand and the remainder in fine-grained material. The proposed Bolinas Lagoon Restoration Project (Federal, if authorized) is considering an alternative that provides dredged materials to the HWRP.

Other potential new work dredging projects that could be future sources of dredged material for the combined project include the San Francisco International Airport Runway Expansion (non-Corps), Southampton Shoal Deepening (Corps), Redwood City Harbor Deepening (Corps) and Concord Naval Weapons Station Deepening (non-Corps).

Other Potential Sources of Dredged Material
There are several small sources of dredged material near the combined project site that may potentially be appropriate for this project. The most likely of these sources is the Bel Marin Keys Community Service District Maintenance Dredging. The community of Bel Marin Keys is located at the northern boundary of the project area. The Bel Marin Keys Community Service District is currently planning a 250,000 cubic yard maintenance dredging project in Novato Creek and the North Lagoon. Another possible source is the Marin County Flood Control and Water Conservation District.

Please see Appendix D for detailed information on the yearly volumes of dredged materials scheduled for placement at the combined project.

2.5 Planning Constraints

Planning constraints are those concerns that must be considered while developing alternative plans. The following descriptions are not environmental assessments; instead, these constraints were used to limit the range of features proposed for this study. The environmental conclusions regarding these constraints are presented in the attached SEIR/EIS.

2.5.1 Minimization of Impact to Existing Threatened and Endangered Species Wetlands

Lowering the levee that separates the project site from Novato Creek to facilitate overflow onto the site during high flow events may create construction-related disturbance of adjacent tidal marsh vegetation and associated wildlife species. In addition, cutting channels through the outboard marshes to restore tidal action to the HAAF, SLC, and BMKV sites will directly impact some salt marsh habitat. Two endangered wildlife species, California clapper rail and salt marsh harvest mouse, may be present in the marsh. In addition, winter-run chinook salmon, Central California coast steelhead, and delta smelt could be present in the marsh channels. Impacts will be minimized during construction. By creating a significantly larger tidal salt marsh, major new habitat areas will be created for these species.

2.5.2 Minimization of Potential Loss of Adjacent Tidal Marsh Habitat

The eastern (San Pablo Bay) and northern (Novato Creek) margins of the project site support mid-and low-marsh habitats that may be lost through the construction of breaches and tidal connecting channels, and because of changes in channel width in Novato Creek associated with increased tidal prism.

To address these concerns, breaches and tidal connecting channels should be located in areas with little or no outboard marsh. In addition, imported dredged material or on-site material should be used to accelerate the development of surface elevations suitable for the establishment of tidal marsh vegetation. Levees may be constructed along marsh basin divides to facilitate construction phasing and reduce the temporal loss of tidal marsh vegetation. However, phase levees will restrict tidal flow between the basins and may provide movement corridors for non-native predators.

2.5.3 Novato Sanitary District Facilities

The Novato Sanitary District (NSD) outfall pipeline runs between the HAAF and SLC property. The outfall extends into San Pablo Bay, discharging into shallow water. The outfall, pipeline and associated facilities must be protected from construction impacts, settling, offshore activities, and changes in elevation as the airfield is filled in to form a wetland. The section of the pipeline through the wetland must remain accessible for inspection and maintenance. An access berm would be constructed along the length of the pipeline that runs through the marsh to allow access for routine maintenance. This berm would create a hydrological separation between the combined BMKV and SLC parcels and the HAAF parcels.

2.5.4 Drainage Infrastructure

The existing drainage infrastructure causes precipitation and storm water runoff that enters the project site to be reduced by pumping and discharged into San Pablo Bay. Removing the pumping station and filling the existing drainage infrastructure would keep the water in the site.

2.5.5 Pacific Gas & Electric Company High Tension Electric Transmission Line Towers

Five PG&E transmission line towers are located in the northern portion of the BMKV site adjacent to Novato Creek. The base of these towers must be protected from erosion and corrosion associated with tidal inundation. Jacketing the base of the towers with concrete is the preferred alternative that has been used at other nearby projects including the Sonoma Baylands Project.

2.5.6 Dredged Material Suitability

Only dredged materials that have chemical concentrations and sediment toxicity below levels that could harm wetland biota will be accepted for this project. Regional dredged material testing guidelines are provided by the LTMS agencies in the Corps of Engineers, San Francisco District, Public Notice 01-01, *Guidelines for Implementing the Inland Testing Manual in the San Francisco Bay Region*. The current regional guidance specific to the chemical suitability criteria for dredged material use in tidal and seasonal wetland restoration projects, upland habitat creation, and other upland uses is contained in the *Long-Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region, Management Plan 2001.*

2.5.7 HTRW

Contamination related to former agricultural use is likely to be present on the BMKV site. The SCC is responsible for all remediation measures and has performed sampling of the BMKV site. SCC has consulted with DTSC and does not anticipate any necessary remediation to impact the addition of BMKV to the authorized HWRP. SCC is also responsible for any remediation necessary to achieve the project purpose of public access on the 2-acre portion of the Bulge area required for the Access Area.

2.5.8 Protection of BMK Residential Community

Breaching the outboard levee would allow tidal waters to flood the Bel Marin Keys residential community. Protecting the Bel Marin Keys residential community from tidal inundation and flooding would require either constructing a new levee or modifying/improving the existing levee separating Bel Marin Keys south lagoon from the project site.

2.5.9 Limited Flood Storage Volume at Pacheco Pond

At present, Pacheco Pond provides an estimated flood storage volume of 866 acre-feet at an elevation of approximately 7 feet NGVD. Enlarging the pond to create additional storage capacity, as proposed in Alternative 1, may reduce its existing water surface elevation and thus result in the loss of wetland habitat. Raising the levee between the pond and the project site to prevent overtopping may increase backwater flooding along Pacheco and Arroyo San Jose Creeks or overtop existing levees at the confluence of the conveyance channel and Novato Creek and at the Leveroni property.

2.5.10 F-2 Flood Zoning and Ponding Covenants

The site is currently under F-1 (primary floodway) and F-2 (secondary floodway) overlay zoning pursuant to the Marin Countywide Plan and is subject to flood protection covenants that restrict development to ensure that the site fulfills a flood protection function for adjacent parcels. The project must be designed to avoid any negative impact on flood risk to adjacent properties.

2.5.11 Scour

Installing water control structures to re-route flows from Arroyo San Jose and Pacheco Creeks (Pacheco Pond) through the project site to reduce the flooding potential may reduce scour and increase sediment deposition (i.e., reduction in channel depth) in Novato Creek downstream of the confluence with the conveyance channel. The project must be designed to minimize impacts associated with scour or to mitigate those impacts if they are unavoidable. Please refer to the SEIS/R for analysis concerning this constraint (Impact TH-3).

2.5.12 Public Access, Privacy, and Compatibility Issues

Providing designated public access to project site along new levees may create privacy and security concerns for Bel Marin Keys residents. Establishment of a segment of the Bay Trail along the western portion of the project site may present incompatibility issues between wildlife well-being and public access. A discussion of the potential impacts and associated mitigation can be found in Sections Impact BIO-34 and Impact BIO-35, in the SEIR/EIS.

2.5.13 No Net Loss of Wetlands

No net loss of total wetland habitat would occur under any of the alternatives; however, creating tidal exchange at the project site and constructing the internal levees would result in the loss of agricultural ponding habitat (agricultural wetlands) totaling approximately 151 acres, based on the ponding analysis conducted as part of the wetland delineation. Because of their size, location, and level of disturbance, these wetlands provide few of the functions and values of higher quality seasonal or other wetlands. Under Alternative 1, approximately 40 acres of seasonal wetlands, 40 acres of open water habitat, 10 acres of freshwater emergent wetland, and 1,039 acres of tidal wetlands would be restored. Under Alternative 2, approximately 210 acres of seasonal wetland and 1,039 acres of tidal wetlands would be restored. As revised, Alternative 2 would restore 899 acres of tidal wetland, 277 acres of seasonal wetland, 12 acres of freshwater emergent wetland and 21 acres of open water habitat. Under Alternative 3, 40 acres of open water habitat, 10 acres of emergent marsh and 1,274 acres of tidal wetlands would be restored. The Draft SEIS/SEIR indicates that the loss of agricultural wetlands is considered less than significant because of the relatively low value of the wetlands and because the loss would be offset by the establishment of both in-kind and out-of-kind replacement wetlands expected to be of higher quality.

3.0 PLAN FORMULATION

3.1 INTRODUCTION

Plan formulation is an iterative process that establishes planning objectives, evaluates management measures that address these objectives, develops potential alternatives that meet the objectives, screens out plans based on comparison criteria, and identifies plans for implementation. This process is consistent with the planning requirements of the Water Resources Council's Principles and Guidelines, the National Environmental Policy Act of 1969, and the U.S. Army Corps of Engineers Planning Guidance Notebook. The process requires systematic development and evaluation of alternatives for alleviating problems and realizing potential opportunities.

This section has two purposes. First, it describes the formulation, evaluation and screening of management measures that address the planning objectives. Second, it describes the formulation of a final array of plans, which display trade-offs between different combinations of management measures. The plans in this final array are candidates for possible recommendation for implementation.

The formulation of the restoration alternatives for the expansion of the HWRP to include BMKV was accomplished through a series of project design team meetings involving staff from the California SCC, the Corps, and BCDC. Input from members of the public, interested organizations, and local, state and federal agency staff was also considered in the development and evaluation of alternatives. Selection of practicable alternatives was based on (1) regional and project-specific goals and objectives; (2) site-specific opportunities and constraints; (3) potential costs and benefits; and (4) potential adverse environmental effects. Plan formulation focused on major design elements (e.g., habitat acreages); minor design elements (e.g., alignment of the Bay Trail) that do not substantially affect the overall design and function of the project will continue to be refined based on public and stakeholder input.

3.2 PLANNING OBJECTIVES

3.2.1 National Objective

Ecosystem restoration is one of the primary missions of the Corps of Engineers Civil Works program. The Corps objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER). Contributions to national ecosystem restoration (NER outputs) are increases in the net quantity and/or quality of desired ecosystem resources. Measurement of NER is based on changes in ecological resource quality as a function of improvement in habitat quality and/or quantity and expressed quantitatively in physical units or indexes (but not monetary units). These net changes are measured in the planning area and in the rest of the Nation. Single purpose ecosystem restoration plans shall be formulated and evaluated in terms of their net contributions to increases in ecosystem value (NER outputs), expressed in non-monetary units.

3.2.2 Project-Specific Objectives

The national objective is a general statement and not specific enough for direct use in plan formulation. The planning objectives are directly related to identifying the problems and opportunities and represent desired positive changes in the without project condition. The planning objectives for this GRR are as follows:

- To design and engineer a restoration project that stresses simplicity and has little need for active management.
- To demonstrate the beneficial use of dredged material, if feasible.
- To recognize existing opportunities and constraints as integral components of design.
- To ensure no net loss of wetland habitat presently provided at the BMKV and HAAF sites.
- To create and maintain wetland habitats that sustain viable wildlife populations, with particular emphasis on supporting Bay Area special-status species.
- To include buffer areas along the upland perimeter of the project area, especially adjacent to residential areas, so wildlife will not be impacted by adjacent land uses.
- To be compatible with adjacent land uses and wildlife habitats.
- To provide for public access that is compatible with protection of resource values and with regional and local public access policies.

In 1996, the National Marine Fisheries Service (NMFS) convened a group of federal and state agency representatives to explore the concept of restoring the HAAF site to tidal wetlands. This group was later expanded into the Hamilton Restoration Group, an advisory body composed of representatives from the City of Novato, state and federal agencies, local landowners, environmental and local interest groups, and other interested parties. The overall project goal is as follows:

To create a diverse array of wetland and wildlife habitats at the HWRP sites that benefit endangered species as well as other migratory and resident species.

3.3 Design Measures

A range of measures was developed for consideration, based in part on input received from the technical and public workshops conducted in Fall 2001. These measures incorporated various options to meet the project purpose and need as well as options to avoid or reduce some of the potential impacts of certain aspects of habitat restoration at the BMKV site. The full range of measures developed was evaluated for feasibility; ability to satisfy the stated project purpose, need, goal, and objectives; and potential environmental effects. Based on this evaluation, a number of measures were dismissed from further consideration; the reasoning for dismissing these measures is discussed for each of the types of measures, below. The measures described here focus on measures applicable to the reauthorization of HWRP to add the BMKV parcel. Measures applicable solely to the currently authorized project are not reanalyzed in this GRR.

3.3.1 Modification of Site Elevation

The majority of the authorized project site and the BMKV parcel have subsided significantly from its historic elevation since being diked off. The typical elevation is -5 feet NGVD. An elevation of +2 feet NGVD is necessary for the establishment of tidal marsh. This GRR considers both the use of suitable dredged material and natural sedimentation processes to bring the site to the desired elevation.

3.3.1.1 Natural Sedimentation

If the BMKV parcel were returned to the tidal action of San Pablo Bay, sediment would accrete by natural processes, and marsh plain elevations would eventually be reached. Complete restoration of tidal wetlands by natural sedimentation is estimated to take up to 50 years. **Restoration of tidal wetlands by natural sedimentation is effective, albeit slow, and is being considered further.** Restoration of tidal wetlands by natural sedimentation was evaluated for the authorized project, but was not part of the selected plan.

3.3.1.2 Use of Dredged Material

The use of dredged material for wetland restoration projects is a beneficial reuse of sediment resources with a net positive environmental effect. Reuse of dredged materials reduces public concern regarding the potential cumulative environmental impacts associated with aquatic dredged material disposal and is consistent with the goals and objectives of the federal and state resource agencies in the region. The authorized project includes use of dredged material to raise site elevations as a major design feature.

One important advantage of using dredged material is the reduction in the amount of time necessary for restored wetlands to become fully functional. This is especially true in the back portion of the parcel/marsh. By filling the restoration site with dredged material, the overall sediment deficit for the system is reduced and velocity gradients are more gradual across the site. With less of the supply being deposited near the inlet, more sediment will be available to the back marsh. The sediments will be more uniformly transported and distributed within the system, and sedimentation will progress more rapidly toward the back marsh. In addition, by filling the restoration site with dredged material, a local sediment supply is established for the back marsh. During tidal channel formation, sediments placed within the system will be redistributed as sediments are scoured from higher-order tidal channels and redeposited in marsh plain areas throughout the site.

Another advantage in using dredged material is that it would allow the creation of design features such as a wildlife corridor connecting habitats to the north and south, tidal pannes, and transitional habitat along the edge of the marsh. The addition of these features would provide a more diverse tidal marsh habitat than would be restored with natural sedimentation alone.

Use of dredged material was considered further because it is consistent with LTMS guidelines, it restores endangered species habitat much sooner than natural sedimentation, and it allows for the restoration of a more diverse tidal marsh ecosystem that would be more efficient to maintain.

3.3.2 Novato Sanitary District Facilities

A Novato Sanitary District treated wastewater pipeline runs along HAAF's northeastern boundary extending between the HAAF and SLC sites to an outfall in San Pablo Bay. The Novato Sanitary District (NSD) serves 60,000 people with two connected treatment plants. During the dry season, treated wastewater is used for spray irrigation on a 1,000-acre reclamation facility along Highway 37. During the wet season, treated wastewater is discharged into San Pablo Bay through the pipeline and outfall. The NSD outfall pipeline runs through a 20-foot wide easement for two miles along the northeast boundary of HAAF and southwest boundaries of the SLC and BMKV parcels. A dechlorination facility is located 1300 feet west of the outboard levee. The outfall extends past the outboard levee into San Pablo Bay, discharging into shallow water. The dechlorination facility lies in an area that will be inundated by sediment and tidal action.

In addition to the currently planned alignment for the authorized HWRP, expansion to include the BMKV parcel allows for two additional pipeline alignments including: routing the pipeline along the central crossing levee or the BMKV/Novato Creek levee (northern alignment), and routing the pipeline along one of the drainage divides between the tidal cells (drainage divide alignment). The alternative routings would permit lowering the existing BMKV/Hamilton berm to allow integration of the tidal marsh restoration areas over time. Either routing would require ongoing maintenance of an access road, and construction of a new outfall to San Pablo Bay.

3.3.2.1 <u>Northern NSD Alignment</u>
The alignment along the northern side of the BMKV site was dismissed from further consideration for the following reasons: except for a potential breach location, a berm for an access road along Novato Creek would remain in place, preventing the integration of the restored tidal wetland with Novato Creek; installation of the new pipeline would require disturbance to the outboard marsh; and location of the outfall near the mouth of Novato Creek could affect water quality in the creek.

3.3.2.2 <u>Drainage Divide NSD Alignment</u>
The alignment along the drainage divide between the new northern tidal cell and the adjacent cell was dismissed from further consideration for the following reasons: this alignment would require construction of a berm for an access road along the drainage divide, which would segregate the northern tidal cell from the rest of the site; additional construction would be necessary for the new berm; and the new outfall would be located closer to the mouth of Novato Creek and could affect water quality in the creek.

3.3.2.3 <u>Currently Planned Alignment</u>
Although constructing the new pipeline along the existing alignment (consistent with the authorized project) would require ongoing maintenance of most of the BMKV/HAAF berm to ensure continuing access for maintenance of the NSD line, the HAAF and the BMKV sites are believed to encompass sufficient tidal marsh acreage to buffer the segregation effects of the NSD line. **Therefore, this measure was carried forward and was considered further.** In addition,

the existing outfall location is as far as possible from the mouth of Novato Creek. If future changes in wastewater routing or treatment technology eliminate the need for this outfall, it might be possible to lower the berm to promote better integration of the sites.

3.3.3 Levees

The project site is neighbored by several properties currently in a variety of uses such as residential, agricultural, recreational, light industrial and wildlife habitat. Actions must be taken to prevent flooding of these properties. The following measures were considered.

3.3.3.1 Staged Construction
As the site is underlain by Bay Mud that is highly compressible, the design must account for settlement of the levees that will occur over time. An alternative design measure, staged construction, was evaluated to address the settlement issue. Staged construction of the levees was considered to recognize the time value of the project investment cost and result in much lower total present value and average annual costs. In addition, staged construction would minimize visual impact to the existing BMK residential community by limiting the levee heights. If staged construction were employed, levee material would have to be temporarily stored on site for future use in levee staged construction as the restored habitat would cover the borrow sites. This would allow the use of on-site borrow without importing fill material. While, staged construction would likely impact the restored habitats, endangered species, and other fish and wildlife that would reside there, **staged construction merits further consideration as this would address the visual impact issue important to the BMK residential community.**

3.3.3.2 Perimeter Levees
To protect the adjacent areas from being flooded once the site was restored to tidal action, the project would require levee construction all around the upland perimeter of the new wetlands except where they would abut the recently constructed NHP levee or higher ground. The new perimeter levee would be designed to replace the level of protection provided by the existing bayfront levee, which would be graded down to high marsh plain elevation by the restoration project.

Existing perimeter levees may need to be improved to facilitate the placement of dredged material and/or provide flood protection. The perimeter containment levees will be used as access roads and will be engineered to support vehicle loads. The levees will also be used to support the delivery pipeline for dredged materials. **Construction of new perimeter levees and improvement of existing perimeter levees was carried forward and was considered further.**

3.3.3.3 Flood Protection Levees
To ensure flood protection for existing communities, flood protection levees were carried forward and considered further. Flood protection levees will be constructed across the western portion of the site to protect the adjacent community from tidal inundation and to create additional open-water habitat. The levees will be designed and constructed to appropriate level of protection. They will typically have gradual side slopes and will be engineered to support

vehicle loads and prevent excessive seepage. Please see Figure 3-12, New Levee Structure, of the attached Supplemental EIS/R.

3.3.3.4 Phase Containment Levees.

Prior to transporting and placing dredged material, a series of internal levees may be constructed within the project site to facilitate phasing. The site will be divided into sub-units based on drainage basin size and configuration. The phase levees will be used as access roads and will be engineered to support vehicle loads. The levees will also be used to support the delivery pipeline for dredged materials. These levees will be degraded to intentional levels once sub-unit construction is complete. Since these levees will be site-specific designs, no typical cross-section is shown. **This measure was carried forward and considered further.**

3.3.3.5 Extend Tidal Reach to Pacheco Pond

Elimination of the levee separating Pacheco Pond from BMKV and construction of no central crossing levee would be feasible if dredged material was placed as fill to raise the existing site grade on BMKV and at Pacheco Pond. Under this scenario, tidal flow would affect the entire pond, changing the existing brackish environment, and could extend farther upstream into Pacheco Creek and Arroyo San Jose. **This measure was dismissed from further consideration for the following reasons**: existing brackish and freshwater environments would be lost; it would conflict with the existing Marin County Flood Control and Water Conservation District-Department of Fish and Game agreement about maintenance of brackish habitat at the pond; and it would not create a diverse array of habitats.

3.3.3.6 Removal of Berm Separating BMKV and HWRP

Complete removal of the berm separating BMKV and the HWRP site would allow integration of the restored tidal marsh and seasonal wetland environments. **This measure was dismissed from further consideration because of the need for the expansion project to accommodate the existing NSD outfall pipeline and the potential replacement pipeline and permit periodic maintenance of the existing and future outfall.**

3.3.4 Internal Peninsulas

Internal peninsulas would be constructed to reduce fetch length on the expanded HWRP site. These peninsulas are needed to reduce internal wave energy during both typical and extreme storm conditions. These peninsulas would also direct the formation of the main tidal channels and thus would protect the perimeter levee system from erosion by these channels. Please see Figure 3-12, Internal Peninsulas of the attached Supplemental EIS/R. **Use of peninsulas has been carried forward for further consideration.**

3.3.5 Breach Options

Breaching the outboard levee that separates the SLC, HAAF and BMKV sites from San Pablo Bay tidal waters is necessary to re-introduce tidal action. Four breach options have been considered in this report.

3.3.5.1 Single Channel Cut for Each Tidal Basin

The option of single channel cuts to each tidal basin has been continued through the evaluation process. In addition to the two cuts for the authorized Project (one cut to the SLC basin and one cut to the HAAF basin) there would be one or two cuts for the BMKV parcel. **This measure was carried forward and considered further.**

3.3.5.2 Single Large Basin, Single Breach

This measure would design the tidal portion of the site with only one basin and one breach for the entire project. This design would reduce the area of existing tidal marsh and mudflat that would be lost due to the creation of new tidal channels. A single basin could be between 1,000 and 1,400 acres in size. Based on experience with other wetland restoration projects and understanding of the hydrology of existing tidal marshes, there are concerns about whether a single breach would be capable of providing sufficient tidal flows to promote natural channel formation and to provide full tidal exchange to a basin of this size. A further concern is that use of a single breach/single basin would not allow a phased approach to completing and opening cells to tidal action. In addition, the option of one main channel cut for all parcels would not satisfy the objective to protect Novato Sanitary District's sewage outfall line by maintaining an access berm between the two portions of the restoration site. **This measure was dismissed from further consideration because of this potential failure to provide hydraulic and biological functionality on restored wetlands.**

3.3.5.3 Many Small Channels

The option of using many small channels to introduce tidal action to the project site was rejected because it results in the maximum impact on the outboard marsh and is less efficient for providing tidal exchange. In addition, a single breach to each sub-basin is desired to promote formation of large subtidal channels that increase wetland complexity and provide habitat for special status species.

3.3.5.4 Breach Location on Novato Creek Near BMK Lock

A breach could be located on Novato Creek near the existing BMK navigational lock. **This breach option was dismissed from further consideration because it would conflict with the provision of an upland buffer adjacent to the BMK residential area and lagoon, and would place tidal marsh habitat in close proximity to residential and recreational users.**

3.3.6 Reclaimed Wastewater

Reclaimed wastewater from either the NSD or the Ignacio Sanitary District could be used to enhance freshwater flows to the expansion restoration site. **This measure was dismissed from further consideration for the following reasons:** flow augmentation would not be necessary to achieve the desired wetland habitats on the site; using reclaimed wastewater in a wetland project adjacent to a residential area has the potential to raise water quality issues; and reuse of wastewater is not among the purposes of this proposed expansion.

3.3.7 Bay Trail Alignments

3.3.7.1 Western Bay Trail Alignment
One Bay Trail alignment would be to extend the Trail northward along the west side of Pacheco Pond to Bel Marin Keys Boulevard. The trail would continue northwest along the western edge of the HWRP restoration area, proceed around the base of Ammo Hill on existing dirt roads, and cross the confluence of Pacheco and San Jose Creeks where they enter Pacheco Pond. This would require the installation of bridges, boardwalks, and/or other infrastructure. After crossing the confluence, the trail would follow the existing MCFCWCD service road and connect to Bel Marin Keys Boulevard via a boardwalk or bridge. **This measure has been carried forward for further consideration.**

3.3.7.2 Eastern Alignment
An alternative alignment considered consists of a trail that follows the existing Pacheco Pond levee, connecting the proposed Bay Trail segment along the southwest boundary of the HAAF parcel to Bel Marin Keys Boulevard. A permanent bridge would be installed to facilitate access across the new weir structure. **This measure was carried forward and considered further.**

3.3.7.3 Outboard Levee Bay Trail Alignment
Another alternative alignment considered consists of a Bay Trail alignment along the San Pablo Bay and Novato Creek outboard levees. It would require pedestrian bridges over breaches in the levee, and would necessitate maintenance of levee integrity. **The outboard levee alignment was dismissed from further consideration for the following reasons:** it is inconsistent with the proposed Bay Trail alignment; it is inconsistent with the authorized HWRP; it would prevent lowering of the outboard levees to allow integration of the restored tidal wetlands with Novato Creek and San Pablo Bay; it would likely result in public access conflicts with threatened and endangered species and their habitats; it is inconsistent with current City of Novato planning for the Bay Trail; and it would generate long-term management costs.

3.3.7.4 Bay Trail Spur
An optional spur of the Bay Trail would be located along the proposed levee separating the upland buffer/swale area from restored tidal wetlands. This spur would terminate at Novato Creek, and a gate would be installed at the Novato Creek terminus to prevent trail users from entering the BMK residential area. **This alignment measure was considered further.**

3.3.8 Alternative Site Location

Because the scope of this study is limited to modifying the already authorized HWRP, it would be inappropriate to consider any sites that are not contiguous with the HWRP site. **Therefore, this measure was dismissed from further consideration.**

3.3.9 Flood Control

3.3.9.1 Flood Control Measure 1

This measure was suggested by MCFCWCD for analysis. This alternative was described in the 1993 EIR prepared for the residential and golf course proposal at BMKV and was as a means of reducing peak flood stage at Highway 37 to 7.0' NGVD to provide an equivalent to the "ultimate channel" described in the Marin County flood control ordinance(Environmental Science Associates 1993). This measure would route Novato Creek flood flows through the BMK south lagoon by taking water, via culvert, when stage on Novato Creek reaches 7.0' NGVD, and then discharging to a large detention basin on the BMKV parcel. The detention basin would be closed to tidal action and would be designed to drain at low tide. This measure would include construction of an additional culvert from Novato Creek to the BMK south lagoon at the location of the three western culverts between the creek and the lagoon and construction of conveyance structures from BMK south lagoon to the detention basin and the detention basin to San Pablo Bay.

Flood control (outside of mitigation were significant adverse physical effects on flooding identified) is not a purpose of the HWRP or the BMKV expansion. As described in Chapter 4 of the attached SEIR/S, the hydrologic and hydraulic analysis concluded that the three restoration alternatives selected for analysis in this document would not have a physical adverse effect on flooding, and that even if it is determined that the project is inconsistent with the local flood zoning ordinance, that this is not a significant effect on the environment. Thus, a flood control feature is not necessary as mitigation because no significant physical adverse effect has been identified. Further, maintenance of a large portion of the site as a detention basin would severely limit the amount of the site that could be restored to tidal wetlands or other habitats, which would not meet the goal and objectives of the project. **Thus, after consideration, this measure was dismissed from further analysis in this document.**

3.3.9.2 Flood Control Measure 2

This alternative feature was also suggested by MCFCWCD for analysis and was described in the 1993 EIR prepared for the residential and golf course proposal at BMKV. This measure was proposed as a means of reducing peak flood stage at Highway 37 to 7.0' NGVD as a means to provide an equivalent to the "ultimate channel" described in the Marin County flood control ordinance (Environmental Science Associates 1993). This alternative feature would include widening Novato Creek from Highway 37 to San Pablo Bay using a by-pass channel near Highway 37 and moving the existing north-side levees northward to expand the existing channel. In order to maintain the initial channel capacity in the by-pass channel and main channel, maintenance dredging would be required, probably on the order of something like every 10 years (or less).

Flood control (outside of mitigation were significant adverse physical effects on flooding identified) is not a purpose of the HWRP or the BMKV expansion. As described in Chapter 4, of the attached SEIS/R, the hydrologic and hydraulic analysis concluded that the three restoration alternatives selected for analysis in this document would not have a physical adverse effect on flooding, and that even if it is determined that the project is inconsistent with the local flood

zoning ordinance, that this is not a significant effect on the environment. Thus, a flood control feature is not necessary as mitigation because no significant physical adverse effect has been identified. This measure would result in significant change in the habitats within the lower portion of the Novato Creek, which includes tidal salt marsh habitat that supports threatened and endangered species. Destruction or alteration of existing special-status species habitat in Novato Creek to build the bypass channel or widening the existing channel is not necessary to conduct the restoration project and is actually counter to the goal of the project, which is to increase the amount of habitat for special-status species. The Novato Sanitary District uses the fields north of Novato Creek as spray-irrigation fields for treated wastewater and construction of new levees or a bypass channel could obstruct this use. These lands are also not under the control or ownership of the project sponsors. **Thus, after consideration, this alternative feature was dismissed from further analysis in this document.**

3.3.10 Access Area

In accordance with Policy Guidance Letter 59, an access area required for a parking lot, restrooms and a kiosk will be located on a 2-acre portion of the 'bulge' property, just west of the HAAF panhandle. This feature will enhance educational and recreational use of the expanded HWRP and by providing proper access, will deter improper excursions into the endangered species habitat. **This measure was carried forward.**

3.3.11 Additional Measures

With the measures described above, there are design requirements that must be included for the formulation of complete alternative plans. These measures include provision of an access road for construction equipment and site maintenance, breaching and removal of the bayfront levee, and demolition of remaining outbuildings. **These measures were carried forward.**

3.3.12 Summary of Measures Dismissed from Further Consideration

Based on input received from the technical and public workshops conducted in Fall 2001, a range of measures was developed for consideration. These measures incorporated various options to meet the project purpose and need as well as options to avoid or reduce some of the potential impacts of certain aspects of habitat restoration at the BMKV site. The full range of measures developed was evaluated for feasibility; ability to satisfy the stated project purpose, need, goal and objectives; and potential environmental effects. Based on this evaluation, the following measures were dismissed from further consideration:

- Northern and Drainage Divide Novato Sanitary District Wastewater Alignments
- Extend Tidal Reach to Pacheco Pond
- Removal of Berm Separating BMKV and HWRP
- Single Large Basin, Single Breach
- Many Small Channels
- Alternative Breach Location on Novato Creek
- Reclaimed Wastewater

- Outboard Levee Bay Trail Alignment
- Alternative Site Location
- Flood Control Measures 1 and 2

3.4 PRELIMINARY ALTERNATIVES

The measures described above were combined into a series of alternatives. The alternatives encompass the range of viable measures. The focus in alternative formulation was on the major design elements (such as the sewer line location and habitat mix), minor design elements (such as the Bay Trail alignment) are also evaluated, but may be refined through public input as the study proceeds.

3.4.1 No Action

The No Action plan is the "without-project" condition that serves as the basis for developing and comparing the impacts of preliminary and candidate plans. Under the No Action Plan of this GRR, the Hamilton Wetland Restoration Project would proceed as authorized, without BMKV, and with potential delays to implement the SLC component (314 acres), the Navy Ballfields (18 acres) and the seasonal wetland portion of HAAF due to uncertainties related to HTRW remediation. If the HWRP is not reauthorized to include BMKV, the SCC would continue to allow use of the site for agricultural production for a few years. Following agricultural use, the site would remain inactive; the SCC would implement a maintenance program to control weeds and retain the integrity of fencing. The perimeter levees would be maintained as flood control levees and would not be breached; natural sedimentation would not occur. If the project site continues to be used in this manner, ground-surface settlement would likely continue to occur at its existing rate. Substantial alteration of natural topography and loss of soil resources capable of supporting sensitive wetland habitats would likely occur. The without project condition assumes that navigation projects will utilize the disposal sites designated under the LTMS implementation plan, as provided in Article II.F. of the HWRP PCA. Please see Appendix A for a detailed description. **This alternative was carried forward and was considered further.**

3.4.2 Beneficial Reuse of Dredged Material with Enlarged Pacheco Pond

This alternative was carried forward and was developed into Alternative 1 in the final array of alternatives. Please refer to Section 3.5 for a detailed description of this alternative.

3.4.3 Beneficial Reuse of Dredged Material with Seasonal Wetlands

This alternative was carried forward and was developed into Revised Alternative 2 in the final array of alternatives. Prior to the public review period, Alternative 2 was entitled 'Beneficial Reuse of Dredged Material with Seasonal Wetlands.' In response to public comments, this alternative was modified. Revised Alternative 2 is entitled 'Beneficial Reuse of Dredged Material with Seasonal Wetlands and Enlarged Pacheco Pond.' Please refer to Section 3.5 for a detailed description of the revised alternative; please refer to Appendix J for a description of Alternative 2, as described prior to the public review period.

3.4.4 Natural Sedimentation

Although the use of natural sedimentation does not meet one of the primary project objectives, beneficial reuse of dredged material, as a response to public interest, natural sedimentation was carried forward to demonstrate its rank in comparison with other alternatives. This alternative was developed into Alternative 3 in the final array of alternatives. Please refer to Section 3.5 for a detailed description of this alternative.

3.4.5 Hybrid of Dredged Material and Natural Sedimentation Approaches

Representing a "middle ground" between the dredged material placement and natural sedimentation measures, this alternative would place dredged material to create appropriate elevations for wetland restoration on a part of the site, and would rely on natural sedimentation for wetland restoration on the remainder of the site. **This alternative was dismissed from further consideration because it does not fully utilize the site for beneficial reuse of dredged material.** If a dredged material placement alternative is selected for implementation and the availability of dredged material of suitable quality becomes a limiting factor at some point in the future, this alternative may be reevaluated.

3.4.6 Habitat Distribution

Habitat distributions considered for the BMKV parcel ranged from: 1) leaving the site in its present state; 2) providing less tidal marsh habitat and more seasonal marsh habitat; 3) providing only tidal marsh habitat; to 4) providing only seasonal wetland habitat.

3.4.6.1 <u>Only Seasonal or Only Tidal Marsh Habitat</u>
The goal of the project is to create a diverse array of wetland and wildlife habitats at HWRP and BMKV to benefit a number of special-status species as well as other migratory and resident species. **Consequently, the "all or nothing" alternatives, such as providing only tidal marsh habitat, were dismissed from further consideration because they would fail to provide a diversity of habitat.**

3.4.6.2 <u>Greater Seasonal Wetland with Less Tidal Marsh</u>
One of the needs for the HWRP is to provide habitat for endangered species. In the context of San Francisco Bay, this means providing habitat for endangered tidal marsh species, such as the salt marsh harvest mouse and the California clapper rail. **Thus, alternatives that did not provide for restoration of substantial areas of tidal marsh were also dismissed from further consideration.** Although a nearly infinite range of possible habitat distributions remain, the distributions selected for detailed evaluation represent a reasonable range of habitat options, and other distributions offering different percentages of the various habitat types were dismissed from further consideration. Whether seasonal wetland habitat could be created depends on the construction method selected – the natural sedimentation measure will not result in the creation of any seasonal wetlands.

3.4.6.3 Historic Bay/Wetland Restoration
Another habitat distribution alternative considered was restoration of the site to "historic" (pre-Gold Rush) conditions. Circa 1850, the Bay shoreline was located near the eastern edge of the BMK south lagoon. Approximately half of the current BMKV site was part of the Bay at that time, while the western remainder of the site supported a tidal marsh complex that received freshwater flow directly from Pacheco Pond and Arroyo San Jose as well as overflow from Novato Creek. It would be possible to restore this circa-1850 habitat mosaic by constructing a new outboard levee along the approximate alignment of the 1850 shoreline, lowering the existing outboard levees, and placing dredged materials as fill or allowing natural sedimentation to create new tidal marsh on the western half of the site. Arroyo San Jose and Pacheco Pond would be rerouted from the outlet at Pacheco Pond to discharge into the restored wetland area. **This alternative was dismissed from further consideration because it would create far less tidal marsh habitat than measures employing habitat restoration on the entire site, and thus would not meet the project objectives as well as other habitat distribution measures.** The habitat distributions retained for analysis are shown in Table 3-1.

3.4.6.4 In-Kind Replacement of Agricultural Wetlands
The 1997 LSA wetland delineation, which was certified by the Corps, identified 155 acres of nonagricultural jurisdictional wetlands and 151 acres of jurisdictional agricultural wetlands. The 151 acres of agricultural wetlands identified in the delineation represent a statistically derived estimate of average ponding acreage within the cultivated fields. Flooded fields provide foraging and resting habitat for a wide diversity of wintering and migrant shorebirds, waterfowl, and other water birds during winter.

One of the identified objectives stipulates that the project shall incur no net loss of wetland habitat presently provided at the BMKV and HWRP sites (see Chapter 1). The preliminary design phase examined several means of achieving this goal. Analysis of "no net loss of wetland habitat" for wetland restoration projects in diked former baylands that are used for agriculture poses unique questions for project sponsors. Acreage is the measure historically used in discussions of compensatory mitigation related to the Corps' national "no net loss" policy, primarily because it has been difficult to identify a single standard for all of the functional components considered during the physical and ecological evaluation required for decision making. "No net loss" is most broadly interpreted as requiring replacement of any lost wetland acreage at a ratio of at least 1:1. Exact in-kind replacement would require retention of at least 151 acres in agriculture and creation of appropriate surface topography to allow those 151 acres to pond every year. Preservation of agricultural activity would likely result in conflict between agricultural use and the protection and enhancement of resources and would require maintenance of these areas, which does not meet the HWRP objective of minimizing active management. Moreover, ponded agricultural habitat is not considered a limiting factor for wildlife along the northern rim of San Pablo Bay. Therefore, creation of exact in-kind replacement of agricultural wetlands was dismissed from further consideration.

While "no net loss" remains Corps policy, as described in the October 31, 2001 Regulatory Guidance Letter, more focus is now being placed on ecosystem approaches to the resource needs of adjacent and surrounding watersheds in developing appropriate mitigation (U.S. Army Corps

of Engineers 2001). In-kind replacement of the 151 acres of agricultural wetlands by creating/restoring seasonal wetlands is feasible at the site. However, any additional seasonal wetland acreage at the site would be created/restored at the expense of acreage that could be devoted to restoring tidal marsh for the benefit of tidal marsh–dependent species, including special-status species. **The alternative consisting of complete in-kind restoration using seasonal wetlands was dismissed from further consideration because it would result in an alternative that would decrease the acreage of tidal marsh created at the site in order to provide acreage of a lower-priority habitat that is not thought to be a limiting factor for wildlife species in and around San Pablo Bay.**

3.4.7 Smaller Restoration Project

A smaller restoration project would include placement of dredged material, establishment of levees and tidal breaching on a far smaller portion of the BMKV site than envisioned in the final array of alternatives. The purpose of this alternative would be to avoid filling, leveeing, placing structures, or undertaking any other activity that would result in diminishment of the nominal ponding capacity of the site by greater than 25%, while maintaining the acreages of existing drainage agreements. The end result would be a restoration area of approximately 317 acres in size. This alternative could comply with the county flood zoning ordinances and existing drainage agreements. Levee structures, maintenance of buffer areas, and a potential Bay Trail alignment would reduce further the available area for wetland restoration. This alternative would result in far fewer benefits to endangered and other wetland-dependent species and would only represent a marginal addition to the habitat value over the HWRP. Further, this alternative does not meet the intent of the Conservancy when it purchased the property, nor the intent of the Corps in early consideration of the potential to add BMKV to the HWRP. **After completion of hydrologic study on the BMKV site and the final array of alternatives showed that the expansion would not have an adverse effect on flooding in the local area, this alternative was dismissed from further analysis.** A second hydrologic study is being conducted on a broader study area to confirm the results of the first study. If this second study identifies an adverse physical hydrologic impact of the restoration alternatives analyzed in this document, then this alternative may be reconsidered. In addition, if resolution of the F-2 zoning cannot be reached in a way that allow any of the alternatives in the final array to proceed, this alternative may be reconsidered at some point in the future.

3.5 FINAL ARRAY OF ALTERNATIVES

For the purpose of the GRR, it is assumed that Alternative 5, the selected and authorized alternative plan for the HWRP, will be implemented. All alternatives developed for this GRR were evaluated in conjunction with the authorized alternative for the HWRP. The authorized HWRP project combined with the without project condition for the BMKV parcel represent the No Action Alternative for this GRR.

In addition to the No Action Alternative, three alternatives, representing a range of potential actions, were developed to incorporate the BMKV parcel into the authorized project:

- Alternative 1 – Dredged Material Placement with Enlarged Pacheco Pond
- Revised Alternative 2 – Dredged Material Placement with Seasonal Wetlands and Enlarged Pacheco Pond
- Alternative 3 – Natural Sedimentation with Enlarged Pacheco Pond.

These were selected as representing a reasonable range of measures for analysis in the GRR. Table 3-1 provides an overview of the three action alternatives for the BMKV increment; *the BMKV increment combined with the existing authorized project represents the entire alternative for reauthorization.* The three action alternatives and the No-Action Alternative are described in greater detail in the text that follows.

Table 3-1 Description of the BMKV Increment for Action Alternatives Considered in this GRR

	No Action	Alternative 1	Alternative 2	Alternative 3
Descriptive Name	No Action	Dredged Material Placement with Enlarged Pacheco Pond	Dredged Material Placement with Seasonal Wetlands and Enlarged Pacheco Pond	Natural Sedimentation with Enlarged Pacheco Pond
Construction Approach	HWRP as authorized	Dredged material placement	Dredged material placement	Natural sedimentation
Design Elements				
Pacheco Pond Expansion	No	Yes	Yes	Yes
Outboard Levee Breaches	1 to San Pablo Bay (SLC) as authorized	2 to San Pablo Bay (BMKV and SLC) and 1 to Novato Creek (BMKV)	1 to San Pablo Bay (BMKV) and 1 to Novato Creek (BMKV)	2 to San Pablo Bay (BMKV)
Habitats	None	1,039 acres tidal wetland 147 acres subtidal and tidal mudflat habitat 40 acres seasonal wetland 10 acres emergent wetland 40 acres open water (pond) 300 acres upland	899 acres tidal wetland 120 acres subtidal and tidal mudflat habitat 277 acres seasonal wetland 12 acres emergent wetland 21 acres open water (pond) 247 acres upland	1,274 acres tidal wetland 197 acres subtidal and tidal mudflat habitat 10 acres emergent wetland 40 acres open water (pond) 55 acres upland
Novato Sanitary District Outfall*	In-kind replacement of NSD outfall in accordance with WRDA '99 authorized project	Minor modification to in-kind replacement of NSD outfall in accordance with WRDA '99 authorized project Extension of new pipeline around east side of Pacheco Pond, with access road/berm.	Minor modification to in-kind replacement of NSD outfall in accordance with WRDA '99 authorized project Extension of new pipeline around east side of expanded Pacheco Pond, with access road/berm.	Minor modification to in-kind replacement of NSD outfall in accordance with WRDA '99 authorized project Extension of new pipeline around east side of Pacheco Pond, with access road/berm.

	No Action	Alternative 1	Alternative 2	Alternative 3
New Levees*	As authorized	From enlarged Pacheco Pond to Novato Creek (central crossing levee); along east side of Pacheco Pond	Around east side of expanded Pacheco Pond' along north and south sides of the seasonal wetland; from BMK/HAAF berm to Novato Creek.	Along east side of Pacheco Pond; from enlarged Pacheco Pond to BMK south lagoon; and along BMK south lagoon to Novato Creek.
Improved Levees*	As authorized	BMK South Lagoon	BMK South Lagoon and portion of BMKV/HAAF; levee west of south lagoon lock	Western portion of BMK South Lagoon
Water Management Structures/ Pacheco Pond and BMK South Lagoon Connections	As authorized	Culverts with flapgates at Pacheco Pond; modified BMK lagoon overflow structures; culvert with flapgate in Novato Creek levee	Overflow structure from expanded Pacheco Pond to seasonal wetland; overflow structure from seasonal wetland to tidal wetland area; modified BMK lagoon overflow; and culvert with flapgate to Novato Creek from swale.	Culverts with flapgates at Pacheco Pond; pump station near BMK south lagoon lock
Bay Trail, Interpretive Center and Access Area	As authorized	Bay Trail along southwest perimeter of HWRP and north from City levee. Bay Trail along west side of Pacheco Pond to Bel Marin Keys Blvd. Spur option 1A between Pacheco Pond and Hamilton seasonal wetlands, and along central levee to Novato Creek. Interpretive Center and access area on property currently owned by the City of Novato west of the HWRP seasonal wetland area.	Bay Trail along southwest perimeter of HWRP and north from City levee. Bay Trail between Pacheco Pond and HAAF and between BMKV seasonal wetlands and Pacheco Pond to Bel Marin Keys Blvd around the west side of Headquarters Hill. Interpretive Center and access area on property currently owned by the City of Novato west of the HWRP seasonal wetland area.	Bay Trail along southwest perimeter of HWRP and north from City levee. Bay Trail between Pacheco Pond and HAAF seasonal wetlands, along east side of expanded Pacheco Pond to Bel Marin Keys Blvd. Spur Option 3A along new levee south of BMK south lagoon levee to Novato Creek. Interpretive Center and access area on northwest side of BMKV.
BMKV Upland Habitat Buffer	None	Upland habitat buffer area in swale south of BMK south lagoon.	Upland habitat buffer area in swale south of BMK south lagoon.	Upland buffer only in area south of the western portion of BMK lagoon.
PG&E Tower Footings	No Action Required	Jacketed to prevent erosion/corrosion	Same as Alternative 1	Same as Alternative 1

*See SEIR/S, Figure 3-12.

3.5.1 No-Action Alternative

Under the No-Action Alternative, the authorized HWRP, habitats would be restored at the HAAF, SLC and Navy Ballfields parcels using dredged material to accelerate marsh establishment and raise elevations for seasonal wetlands. This alternative would result in 950 acres of habitat. Ten million six hundred thousand (10,600,000) cubic yards of dredged material from various bay area projects would be used. No wetland restoration would take place at the BMKV site and no Bay Trail alignment would be constructed through the BMKV property.

Potential delays in habitat restoration at the SLC parcel (314 acres), the Navy Ball Fields (18 acres) and the seasonal wetland portion of HAAF may occur due to BRAC and FUDS issues.

Under this alternative, it is assumed that the Corps, Conservancy or their successors in interest would:

- allow agriculture to continue on the BMKV site for a few years, then implement fence maintenance and weed control programs;
- continue to operate and maintain drainage and pumping facilities on the site;
- maintain levees, and
- implement the Hamilton Wetland Restoration Project, including construction of a perimeter flood protection levee along the boundary between the HWRP restoration site and the BMKV parcel.

3.5.2 Alternative 1 – Dredged Material Placement with Enlarged Pacheco Pond

3.5.2.1 <u>Restoration Features</u>

Alternative 1 consists of the authorized Project and the BMKV increment. Figure 3-1 depicts Alternative 1 at maturity. Under Alternative 1, a diverse array of tidal (tidal marsh, tidal flat, and subtidal) and nontidal (high-transitional marsh, seasonal wetland, perennial wetland, perennial open water, and upland) habitat types would be restored to the project site. Imported dredged material that has been determined to be suitable wetland cover material according to DMMO requirements would be used to create upland and seasonal wetland habitats and to create surface elevations suitable to accelerate the initial establishment of tidal marsh vegetation. Final marsh plain elevations would develop over time through the natural deposition of sediments from San Pablo Bay, supporting the establishment of tidal marsh vegetation. The acreage of each habitat type restored within the BMKV increment under Alternative 1 is shown in Table 3-3.

In the eastern portion of the BMKV parcel, three tidally influenced sub-basins, each approximately 400 acres in size, would be created as cells to facilitate the placement of dredged material and the establishment of tidal marsh vegetation. Dredged material would be placed in each sub-basin to create surface elevations ranging from approximately 2 feet NGVD (approximately 1 foot below Mean High Water [MHW]) along the basin perimeter to approximately 0 NGVD near the outboard levee. Additional dredged material would be placed in the southeast corner of the BMKV Parcel to create surface elevations (approximately 3.5 feet NGVD) suitable for the establishment of high transitional marsh vegetation. After fill placement

activities have been completed, the outboard levees would be breached in three locations to restore the hydrologic connections to San Pablo Bay and Novato Creek. The levee along Novato Creek would be lowered to facilitate overflow onto the expansion site from Novato Creek during peak storm events. The levee along San Pablo Bay would also be lowered to create topographic diversity and facilitate the establishment of transitional marsh vegetation. Several high points along the levee will be left as high-tide refugia. Final marsh plain elevations would be established via natural deposition of fine-grained sediments from San Pablo Bay and Novato Creek. Final tidal wetland surface elevations in the three marsh sub-basins would range from approximately 0.5 to 3.5 feet NGVD.

A levee approximately 10 feet in elevation would be constructed across the northwestern portion of the BMKV parcel to separate the nontidal and tidal habitats. The outboard (east) side of the levee would be constructed with a gentle side slope that would transition from upland to high- to mid-marsh habitat types. The inboard (west) side of the levee would be constructed with a gradual slope from a base elevation of 1 foot NGVD to a crest 10 feet NGVD. The existing levee along the BMK south lagoon would be improved (top elevation approximately 6 feet NGVD), and an overflow structure or structures would be installed to convey overflow from the lagoon into the swale area. Overflow from the lagoon and seasonal precipitation would support the establishment of seasonal wetland habitat in the swale located between the two levees. Plant species composition in this area would vary according to salinity, inundation frequency, and duration; however vegetation would likely consist of emergent wetland vegetation (e.g., bulrushes, cattails, rushes), and grasses and forbs.

In the northwestern portion of the BMKV parcel, approximately 50 acres of perennial open water and wetland habitat would be created by enlarging Pacheco Pond. The levee that now separates the BMKV parcel from Pacheco Pond would be breached in several locations to provide a larger contiguous area of open water habitat. The bottom elevation of Pacheco Pond would remain at the existing elevation of –3 feet NGVD, and the pond would continue to be managed to maintain a surface water level of approximately 1.5 feet. Sections of the levee would be left in place to provide roosting and nesting habitat for shorebirds. A bench would be constructed along the inboard perimeter of the new pond levee to promote the establishment of freshwater emergent marsh vegetation. A culvert structure would be installed in the new pond levee to allow the release of overflow waters from the pond into the tidal marsh basin. A significant portion of existing Pacheco Pond storm runoff might be directed through the tidal marsh basin.

The salinity of the water in the channel flowing through the tidal marsh basin would vary, depending on the outflow from Pacheco Pond and the extent of tidal inundation. As water is released from Pacheco Pond following large winter storm events, salinities within the channel would vary from freshwater values near the overflow to brackish and marine levels as water flows into the marsh basin. During extreme high tides, the channel would be inundated by tidal flow and salinity would increase to near marine levels. The freshwater pond environment would not be affected during these periods because the flapgate would prevent tidal flows from entering the pond. During the summer months and dry times of the year, the salinity of water in the channel would be comparable to that found in San Pablo Bay.

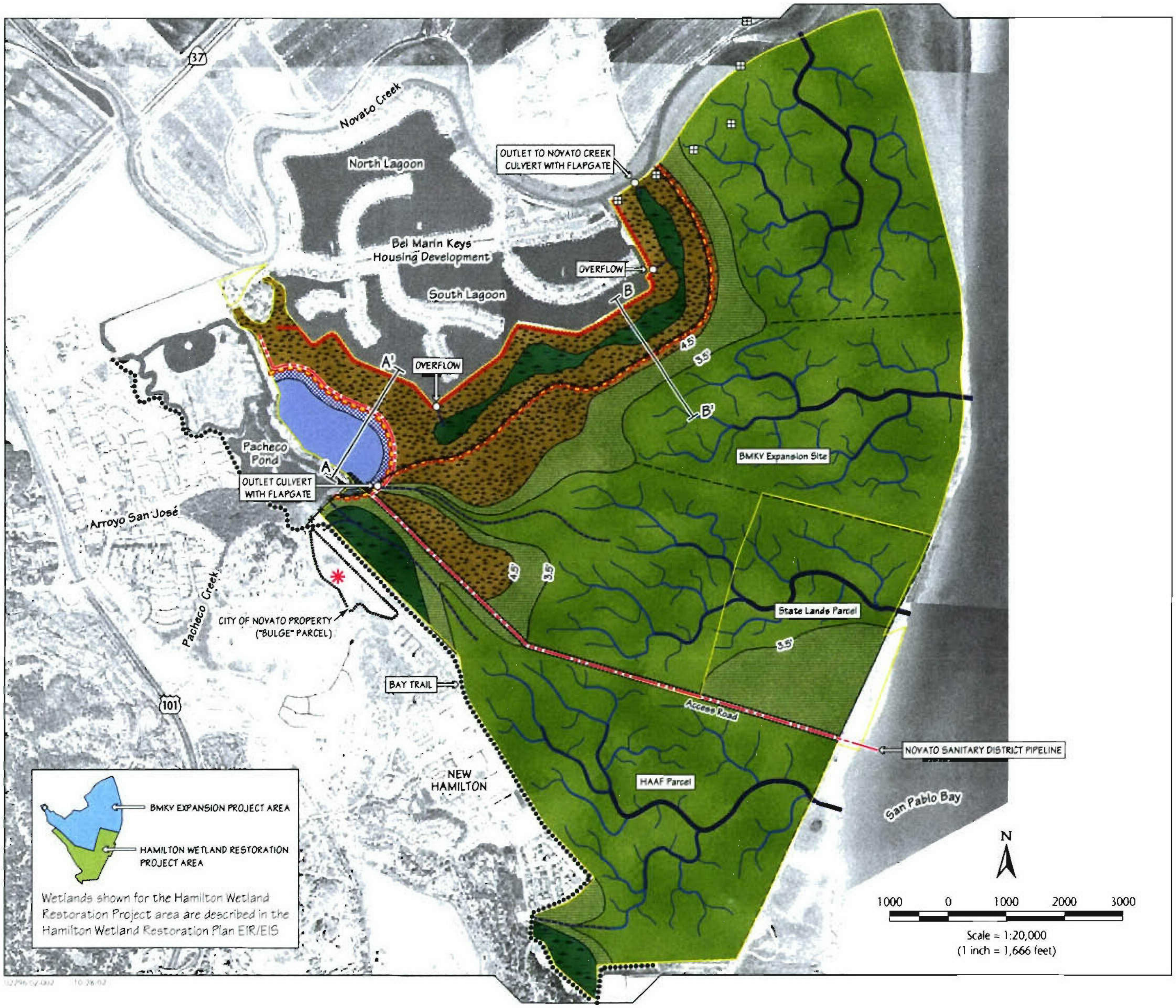


Figure 3-1
Bel Marin Keys Restoration Alternative 1 at Maturity

Legend

HABITAT TYPES
- Upland Transition
- Freshwater Emergent Wetland
- Seasonal Wetland
- High Transitional Marsh
- Tidal Salt Marsh
- Open Water

CHANNEL ORDER
- Primary channels
- Secondary channels
- Tertiary channels
- Small branches
- Sub-basin Boundary

INFRASTRUCTURE
- Overflow Channel and Structure
- New Levee
- Improved Levee
- Existing Levee
- Bay Trail
- Spur Option 1A
- Power Tower
- Novato Sanitary District Pipeline
- Interpretive Center (not part of federal project; access area adjacent, not shown)

Note: Vertical elevations are relevant to NGVD 1929.

See Figure 3-2 for cross sections A–A' and B–B'.

Jones & Stokes

nhc

Alternative 1 would include the installation of a new or retrofitted sanitary outfall pipeline along the berm (the existing alignment) that separates the expansion site from the adjacent HWRP parcel. The existing pipeline would be replaced or retrofitted because of differential settling and leakage. The new pipeline would be installed slightly below the grade of the existing pipeline; the existing outfall pipeline would be abandoned in place to provide protection from scour associated with the formation of tidal channels. The NSD pipeline would be realigned around the east side of the expanded Pacheco Pond.

3.5.2.2 Recreation Features

The authorized HWRP has a Bay Trail alignment along the City of Novato levee along the west side of the HWRP site. Alternative 1 would also include construction of public access facilities. Under this alternative, the Bay Trail would be extended southward from the terminus of the existing trail at the pump station near the Hamilton baseball field, along the southwestern perimeter of the HWRP to a point approximately 700 feet from the existing outboard marsh. The trail would follow either the existing road or new levee constructed for the HWRP until it meets the existing perimeter levee. The trail would then follow the path of the existing perimeter levee north and eastward. The Bay Trail also would be extended northward from the City levee along the west side of Pacheco Pond to Bel Marin Keys Boulevard. The trail would continue northwest along the western edge of the HWRP restoration area, proceed around the base of Ammo Hill on existing dirt roads, and cross the confluence of Pacheco and San Jose Creeks where they enter Pacheco Pond. This would require the installation of bridges, boardwalks, and/or other infrastructure. After crossing the confluence, the trail would follow the existing MCFCWCD service road and connect to Bel Marin Keys Boulevard via a boardwalk or bridge. This proposed alignment is outside lands currently owned by the SCC. If the selected plan includes this alignment of the Bay Trail and associated recreation features and there is any contamination on the required property, the non-Federal sponsor, SCC will adequately remediate the site for the project purpose. If the feasibility of locating recreation features on these parcels is not demonstrated, i.e., remediation issues are not resolved, the location of recreation features currently shown in Alternative 2 will be used.

Spur Option 1A (Figure 3-1) would include a spur trail eastward from the Bay Trail across the levee between Pacheco Pond and the HWRP, and along the proposed levee separating the upland buffer/swale area from the restored tidal wetlands to Novato Creek. This spur would terminate at Novato Creek, and a gate would be installed at the Novato Creek terminus to prevent trail users from entering the BMK residential community.

Final site-specific design of the new Bay Trail alignments has not been completed, but may include some of the following components (Questa Engineering 2001):

- Locating the trail on the mid-slope of the levee to minimize visual disruption of sensitive wildlife;
- Designing the trail to ensure a buffer between the trail alignment and sensitive habitat areas, and providing overlooks or vista points offering views of buffer zones and adjacent habitat areas;
- Installing fencing to prevent intrusion by humans and pets;

- Grading a topographic separation or constructing trail segments at low elevations relative to adjacent residential areas to provide privacy;
- Closing trail segments near nesting areas seasonally;
- Installing vegetative buffers to preclude access to sensitive areas;
- Installing a gated entry to exclude motorized vehicles; and
- Restricting dog access.

Additional public access facilities proposed under Alternative 1 include an interpretive center located east of Ammo Hill and south of the HWRP seasonal wetland restoration area. The interpretive center would be located along the road designated as the HWRP wetland restoration access road, and is conceptually envisioned as an approximately 1,000-square-foot building housing exhibits that provide information about the wetland restoration projects and the local flora and fauna. Restrooms and limited parking (approximately 10–20 spaces) would be provided. The interpretive center would serve as a trailhead and would be connected to the proposed Bay Trail alignment via new trails routed along existing dirt roads. The interpretive center is not a part of the federal project, and as such would be the full responsibility of the non-Federal sponsor.

3.5.2.3 Summary of Resultant Changes to Authorized HWRP

The following changes to the authorized HWRP would occur if Alternative 1 were implemented:

- Elimination of levee between BMKV and SLC parcels
- Replacement of levee between HAAF and SLC parcels with an access berm
- Rerouting the authorized realignment of the NSD outfall pipeline
- Increase and change in location of high transitional marsh on the SLC parcel

3.5.3 Revised Alternative 2 – Dredged Material Placement with Seasonal Wetlands and Expanded Pacheco Pond

After consideration of the comments provided by agencies, individuals, and organizations on the draft document, design requirements, and environmental factors, and review of the project goals and objectives, Alternative 2 was revised. The following outlines the major revisions made to the design of Alternative 2. Major features of Revised Alternative 2 are presented in Table 3-2. A detailed description of Revised Alternative 2 follows; a detailed description of Alternative 2, prior to modification, is presented in Appendix J.

1) Expansion of the swale south of the BMK south lagoon from 230 acres to 388 acres (including 247 acres of upland and 141 acres of seasonal wetland);

2) Addition of a 21-acre expansion of Pacheco Pond with a 12-acre emergent marsh;

3) Construction height of South Lagoon levee changed to6 feet NGVD (designed to settle to design height of 5 feet NGVD) previously 10' NGVD);

4) Construction height of new levees from 12 feet NGVD to 10 feet NGVD (with settlement to design height of 8 feet NGVD;

5) Relocation of new outboard levee to 1500 feet south and east of the existing BMK south lagoon levee;

6) Improvements to the South Lagoon levee lock structure and levee west of structure to minimize Novato Creek bypass flows to south lagoon;

7) Removal of Spur Trail Option 2A to Novato Creek; routing of Bay Trail around west side of Headquarters Hill;

8) Relocation of the Interpretive Center and Access Area from BMKV to the City of Novato property on HAAF; and

9) Designation of primary construction road access from Hamilton and secondary access from Bel Marin Keys Boulevard.

Table 3-2 Summary of Revised Alternative 2: Dredged Material Placement with Seasonal Wetland and Enlarged Pacheco Pond

Habitats	899 acres tidal wetland and 120 acres other tidal habitats 277 acres seasonal wetland 247 acres upland
Outboard Levee Breaches	Novato Creek (BMKV); San Pablo Bay (BMKV)
Novato Sanitary District Outfall	Access road/berm (4–6' NGVD) and extension of 400' of new pipeline around east side of Pacheco Pond. Authorized HWRP already includes replacement/retrofit of existing pipeline and relocation of dechlorination plant.
New Levees	From enlarged Pacheco Pond to Novato Creek (8–10' NGVD). Along north and south sides of seasonal wetland (8-10' NGVD) Around east side of enlarged Pacheco Pond (8-10' NGVD)
Improved Levees	BMK south lagoon (5–6' NGVD)
Water Management Structures/Pacheco Pond and BMK S. lagoon connections	Culvert with flapgate from seasonal wetland to tidal wetland area Culvert with flapgate in Novato Creek levee to drain swale area Modified BMK lagoon overflow
Bay Trail, Access Area and Interpretive Center	Bay Trail along southwest perimeter of HWRP and north from city levee and along east side of Pacheco Pond to Bel Marin Keys Blvd around the west side of Headquarters Hill. Access Area on 2 acres of Bulge property west of HWRP seasonal wetland area. Interpretive Center on City land west of HWRP seasonal wetland area.

3.5.3.1 <u>Restoration Features</u>

Figure 3-2 depicts Revised Alternative 2 at maturity. Under Revised Alternative 2, tidal (tidal marsh, tidal flat, subtidal) and nontidal (high-transitional marsh, seasonal wetlands, upland) habitat types would be restored to the expansion site. Imported dredged material (determined to

be suitable wetland cover material based on DMMO requirements) would be used to create upland and seasonal wetland habitats, and to create surface elevations suitable to accelerate the establishment of tidal marsh vegetation. Final marsh plain elevations would develop over time through the natural deposition of sediments from San Pablo Bay, supporting the establishment of tidal marsh vegetation. The acreage of each habitat type restored within the BMKV increment under Revised Alternative 2 is shown in Table 3-3.

In the eastern portion of the site, two tidally influenced sub-basins, each approximately 600 acres in size (the southern basin includes the SLC site), would be created as cells to facilitate the placement of dredged material and the establishment of tidal marsh vegetation. Dredged material would be placed in each sub-basin to create surface elevations ranging from approximately 2 feet NGVD (approximately 1 foot below MHW) along the basin perimeter to approximately 0 NGVD near the outboard levee. Additional dredged material would be placed in the southeast corner of the SLC site to create surface elevations (approximately 3.5 feet NGVD) suitable for the establishment of high-transitional marsh vegetation. After placement activities have been completed, the outboard levees would be breached in 2 locations to restore the hydrologic connections to San Pablo Bay and Novato Creek. The levee along Novato Creek would also be lowered to facilitate overflow onto the expansion site from Novato Creek during peak storm events. The levee along San Pablo Bay would also be lowered to facilitate the establishment of mid-high marsh vegetation. Several small portions of the outboard levees will be left in place as high-tide refugia. Final marsh plain elevations would be established through the deposition of fine-grained sediments from San Pablo Bay and Novato Creek. Final surface elevations in the 2 marsh sub-basins would range from approximately 0.5 to 3.5 feet NGVD. Elevations in the channel bottoms would ultimately be lower, particularly at the breach.

A levee with an initial top elevation of approximately 10 feet NGVD (with a 2-foot settlement allowance, resulting in a design elevation of 8 feet NGVD) would be constructed across the middle portion of the site to separate the non-tidal and tidal habitats. The outboard (east) side of the levee would be constructed with a gentle side slope that would transition from upland to high- to mid-marsh habitat types. The inboard (west) side of the levee would slope gradually from the crest of 10 feet NGVD to a base elevation of approximately –1.5 to -1 foot NGVD in the bottom of the swale and approximately –1 to 0 feet NGVD in the seasonal wetland. The existing levee along the BMK south lagoon would be improved to an initial top elevation of 6 feet NGVD, which includes a 1-foot settlement allowance, resulting in a design elevation of 5 feet NGVD. This alternative includes an overflow structure or structures that would be installed to convey overflow into the swale area. Overflow from the lagoon as well as seasonal precipitation would support the establishment of approximately 141 acres of seasonal wetland habitat in the swale located between the 2 levees. Plant species composition in this area would vary according to salinity and inundation frequency and duration; however, vegetation would likely consist of emergent wetland vegetation (e.g., bulrushes, cattails, rushes), and grasses and forbs.

Under Revised Alternative 2, Pacheco Pond would be expanded by 21acres on its eastern side. The expanded pond would also include 12 acres of emergent marsh habitat on its eastern border with the Bay Trail. A new levee would be constructed around the new eastern boundary of

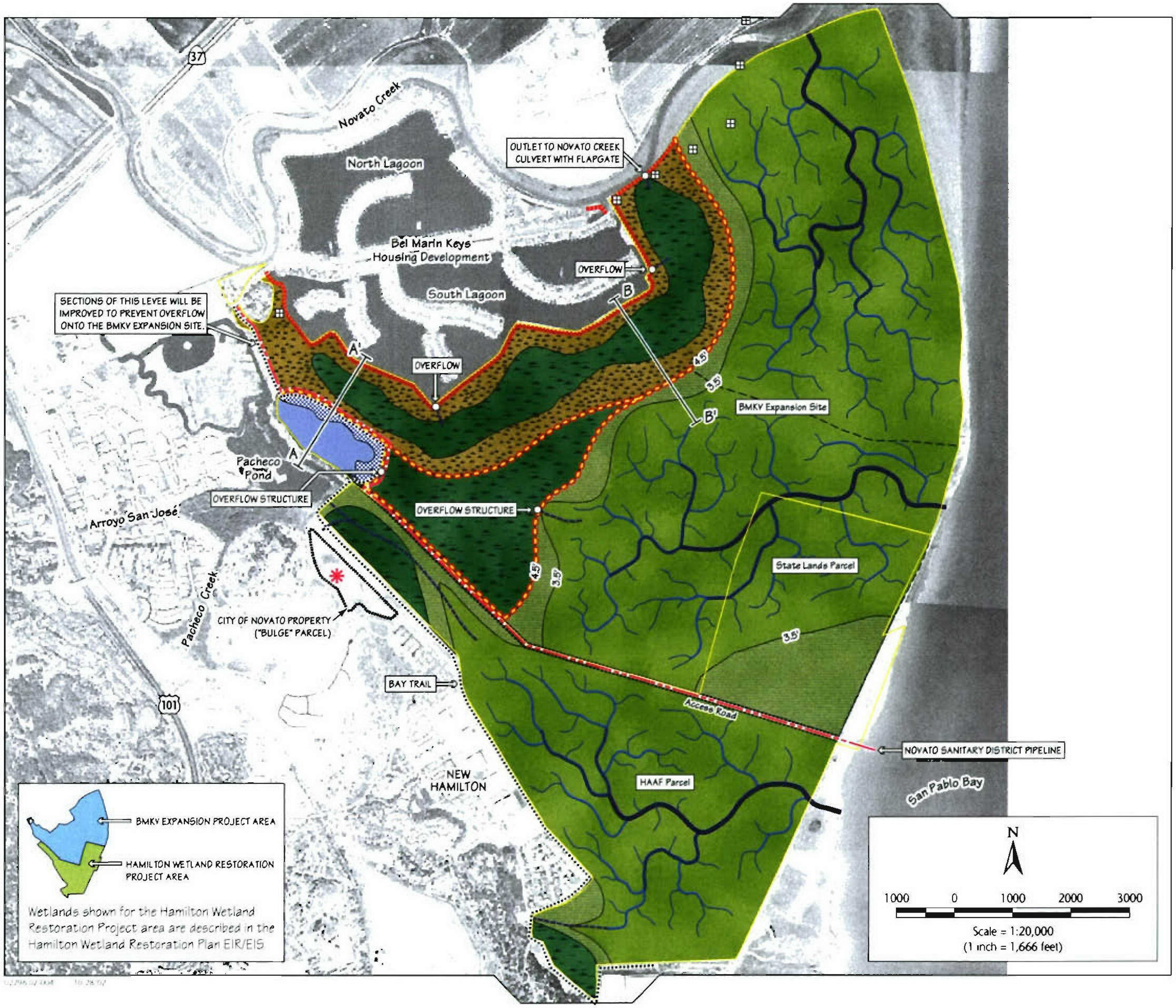


Figure 3-2
Bel Marin Keys Restoration
Revised Alternative 2 at Maturity

Legend

HABITAT TYPES

- Upland Transition
- Freshwater Emergent Wetland
- Seasonal Wetland
- High Transitional Marsh
- Tidal Salt Marsh
- Open Water

CHANNEL ORDER

- Primary channels
- Secondary channels
- Tertiary channels
- Small branches
- Sub-basin Boundary

INFRASTRUCTURE

- Parcel Boundary (see inset)
- Overflow Channel and Structure
- New Levee
- Improved Levee
- Existing Levee
- Bay Trail
- Power Tower
- Novato Sanitary District Pipeline
- Interpretive Center (not part of federal project; access area adjacent, not shown)

Notes:

Vertical elevations are relevant to NGVD 1929.

Sections of the levee north of Pacheco Pond will be improved to prevent overflow onto the BMKV expansion site.

See Figure 3-6 for cross sections A–A' and B–B'.

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Pacheco Pond. The existing Pacheco Pond levee would be breached in several locations to unify the existing and new portions of the pond. Several portions of the existing levee may be left in place to create habitat islands.

In the northwestern portion of the site, approximately 136 acres of seasonal freshwater wetlands (e.g., cattails, bulrushes, sedges) would be created by constructing surrounding levees to impound freshwater flows and by routing overflow from Pacheco Pond. The outboard levee would also prevent the seasonal wetland habitat area from being inundated during high tides. An adjustable weir would be installed in the new levee around the east side of the expanded Pacheco Pond levee to facilitate overflow into the seasonal wetland habitat area when surface water elevations in Pacheco Pond exceed 2 feet NGVD (the managed surface water elevation). A culvert structure would be installed in the new outboard levee to allow the release of overflow waters from the seasonal wetlands into the tidal marsh basin. A significant portion of Pacheco Pond flood flows may be released into the tidal marsh basin.

Under this alternative, Pacheco Pond would have 2 outlets: the existing outlet to Novato Creek via the outlet channel, and a new outlet to the seasonal wetland area on BMKV. CDFG and MCFCWCD have an existing agreement to manage Pacheco Pond for the dual purposes of flood control and wildlife. The BMKV expansion would include development of a new water management plan for Pacheco Pond, which the Conservancy or successors, CDFG, and MCFCWCD would jointly implement to continue to manage flood control and wildlife. The existing outlet would continue to operate and would receive all flow in summer (as the seasonal wetlands would not require summer flow). The new water management plan would determine the operational parameters of the two outlets in winter and during high-stage/flow events.
The authorized HWRP includes the relocation of the NSD dechlorination plant and the replacement or retrofit of the existing NSD pipeline as described above under Alternative 1. This alternative includes construction of an access road/berm and construction of a new section (approx. 400 feet) of pipeline around the east side the expanded Pacheco Pond. NSD would access the pipeline by existing, new, or improved levees leading to an improved berm along the existing alignment (at the property line separating BMKV from HAAF). The top of the berm would be built to between 4 and 6 feet NGVD, which is similar to Alternative 1, except that under Revised Alternative 2, a 2,000-foot section southeast of Pacheco Pond would be built to between 8 feet and 10 feet NGVD because this portion of the levee would separate the seasonal wetland area from a part of the HAAF parcel that could receive tidal flow.

3.5.3.2 Recreation Features

Under this alternative, the Bay Trail would be extended southward from the terminus of the existing trail at the pump station near the Hamilton baseball field, and then proceed along the southwestern perimeter of the HWRP to a point approximately 700 feet from the existing outboard marsh, as described above for Alternative 1.

Also under this alternative, the Bay Trail would proceed northward from the City of Novato levee along the western edge of the HWRP to Pacheco Pond, cross the levee between Pacheco Pond and the HWRP, proceed around the east side of the expanded Pacheco Pond and then proceed northward along the levee between Pacheco Pond and BMKV to Bel Marin Keys

Boulevard around the west side of Headquarters Hill. A permanent bridge would be installed to facilitate access across the new weir structure on the levee around the east side of expanded Pacheco Pond.

As part of the Federal project, an access area would be provided to the west of the HAAF panhandle, on a 2-acre portion of the Bulge parcel. Restrooms, limited parking (approximately 10 to 20 spaces) and an information display board would be provided. The Access Area would serve as a trailhead and would be connected to the proposed Bay Trail routes by new trails routed along existing dirt roads. Revised Alternative 2 does not include a spur trail option to Novato Creek. In addition, an interpretive center for the HWRP and BMKV expansion will be built by others and located adjacent to the access area. The site is on City of Novato property west of the seasonal wetland area at Hamilton in the same location as described above under Alternative 1. The interpretive center is conceptually envisioned as an approximately 1,000-square-foot building that would house exhibits that provide information about the wetland restoration projects and the local flora and fauna. The interpretive center is not a part of the federal project, and as such would be the full responsibility of the non-Federal sponsor.

3.5.3.3 Summary of Changes to Authorized HWRP

The following changes to the authorized HWRP will occur if Revised Alternative 2 is implemented:

- Elimination of levee between BMKV and SLC parcels
- Replacement of Levee between HAAF and SLC parcels with an access berm
- Repositioning of the breach location off the SLC parcel
- Increase and change in location of high transitional marsh on the SLC parcel
- Rerouting the authorized realignment of the NSD outfall pipeline.

3.5.4 Alternative 3 – Natural Sedimentation with Enlarged Pacheco Pond

3.5.4.1 Restoration Features

Alternative 3 consists of the authorized Project and the BMKV increment. Figure 3-3 depicts Alternative 3 at maturity. Under Alternative 3, a diverse array of tidal (tidal marsh, tidal flat, subtidal) and nontidal (high-transitional marsh, seasonal wetlands, perennial open water and upland) habitat types would be restored to the expansion site. Site soils and sediments would be used to establish the base for the high transitional marsh and upland transition on majority of the expansion site. On 90 acres of the southeastern corner of the SLC parcel, dredged material would be placed to establish high transitional marsh habitat. Final marsh plain elevations and vegetation would become established over time through the natural deposition of sediments from San Pablo Bay. The acreage of each habitat type that would be restored for the BMKV increment under Alternative 3 is shown in Table 3-3.

In the eastern portion of the site, two tidally influenced sub-basins, each approximately 700 acres in size, would be created as cells to facilitate the establishment of tidal marsh vegetation. The outboard levee would be breached in two locations to restore the hydrologic connection to San Pablo Bay. The BMKV parcel would initially consist of open water. Final marsh plain elevations would be established through natural deposition of fine-grained sediments from San

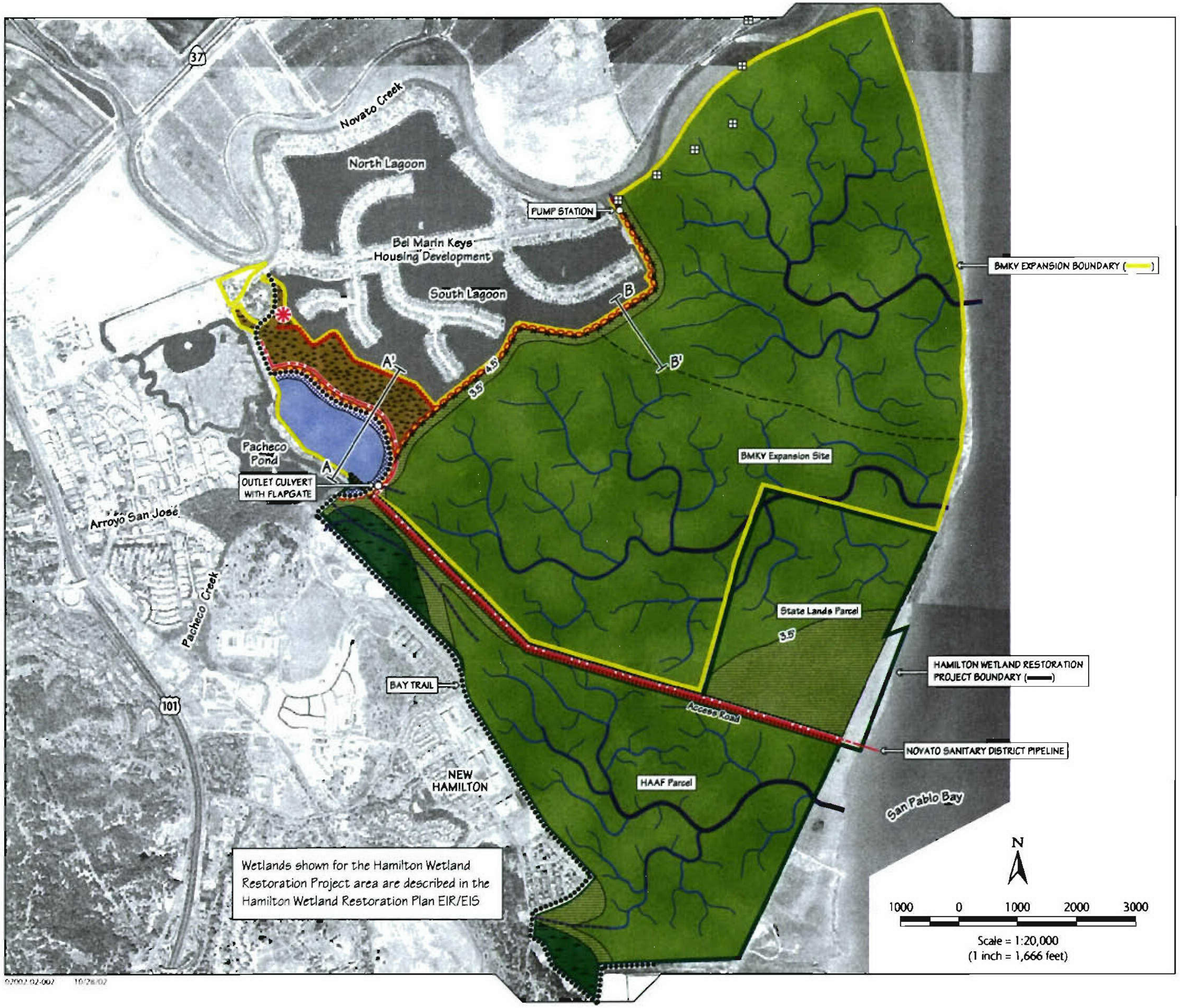

Figure 3-3
Bel Marin Keys Restoration
Alternative 3 at Maturity

Legend

HABITAT TYPES
- Upland Transition
- Freshwater Emergent Wetland
- Seasonal Wetland
- High Transitional Marsh
- Tidal Salt Marsh
- Open Water

CHANNEL ORDER
- Primary channels
- Secondary channels
- Tertiary channels
- Small branches
- Sub-basin Boundary

INFRASTRUCTURE
- Overflow Channel and Structure
- New Levee
- Improved Levees
- Existing Levees
- Bay Trail
- Spur Option 3A
- Existing Power Towers
- Novato Sanitary District Pipeline
- Interpretive Center (not part of federal project)

Note: Vertical elevations are relevant to NGVD 1929.

See Figure 3-9 for cross sections A–A' and B–B'.

Coastal Conservancy

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Pablo Bay. Final surface elevations in the two marsh sub-basins would range from approximately 0.5 to 3.5 feet NGVD.

A levee with an elevation of approximately 10 feet NGVD would be constructed along the northwestern portion of the site following the existing BMK south lagoon levee. The outboard (east) side of the levee would be constructed with a gently sloping bench, approximately 100 feet wide, to protect the levee from wind and wave erosion and to create a band of high-marsh transition habitat. The inboard (west) side of the levee would slope gradually from the crest of 10 feet NGVD to a base elevation of 5 feet below NGVD. The western portion of the existing BMK south lagoon levee near Bel Marin Keys Boulevard would be improved (approximate top elevation of 6 feet NGVD), and a seasonal wetland swale would be constructed between the levee and the expanded Pacheco Pond. A pump would be installed near the east navigation lock to convey overflow from the south lagoon into Novato Creek. A second bench, also approximately 100 feet wide, would be constructed along the north side of the existing levee that separates the BMKV parcel from the HAAF parcel, to protect the levee from wind and wave erosion and to create a band of high-marsh transition habitat.

In the northwestern portion of the BMKV parcel, approximately 50 acres of perennial open water and wetland habitat would be created by enlarging Pacheco Pond. The levee that now separates the BMKV parcel from Pacheco Pond would be breached in several locations to provide a larger contiguous area of open water habitat, and a new levee would be built further southeast. Sections of the levee would be left in place to provide nesting habitat for shorebirds. The bottom elevation of Pacheco Pond would remain at the existing elevation of –3 feet NGVD, and the pond would continue to be managed to maintain a surface water level of approximately 1.5 feet following enlargement of the pond. A bench would be constructed along the inboard perimeter of the new pond levee to promote the establishment of freshwater emergent vegetation. A culvert structure would be installed in the new pond levee to allow the release of overflow waters from the pond into the tidal marsh basin.

As for Alternative 1, the salinity of the water in the channel flowing through the tidal marsh basin would vary, depending on the outflow from Pacheco Pond and the extent of tidal inundation. As water is released from Pacheco Pond following large winter storm events, salinities within the channel would vary from freshwater values near the overflow to brackish and marine levels as water flows into the marsh basin. During extreme high tides, the channel would be inundated by tidal flow and salinity would increase to near marine levels. The freshwater pond environment would not be affected during these periods because the flapgate would prevent tidal flows from entering the pond. During the summer months and dry times of the year, the salinity of water in the channel would be comparable to that found in San Pablo Bay.

Under this alternative, a new or retrofitted outfall pipeline would be installed along the berm (the existing alignment) that separates the expansion site from the adjacent HAAF parcel. The existing pipeline would be replaced or retrofitted because of differential settling and leakage. The new pipeline would be installed slightly below the grade of the existing pipeline; the existing outfall pipeline would be abandoned in place to provide protection from scour

associated with the formation of tidal channels. The new NSD pipeline would be built in a new alignment around the eastern side of Pacheco Pond.

3.5.4.2 Recreation Features

Under this alternative, the Bay Trail would be extended southward from the terminus of the existing trail at the pump station near the Hamilton baseball field, along the southwestern perimeter of HWRP to a point approximately 700 feet from the existing outboard marsh. This trail alignment is similar to that described for Alternative 1. Public access also would be provided by a trail that follows the expanded Pacheco Pond levee, connecting the proposed Bay Trail segment along the southwest boundary of the HAAF parcel to Bel Marin Keys Boulevard. An optional spur of the Bay Trail would be located along the inboard side of the BMK south lagoon levee. This spur would terminate at Novato Creek, and a gate would be installed at the Novato Creek terminus to prevent trail users from entering the BMK residential area. Also under this alternative, an interpretive center for the Hamilton/BMKV Wetland Restoration Project would be constructed as described for Alternative 2. The interpretive center is not a part of the federal project, and as such would be the full responsibility of the non-Federal sponsor.

3.5.4.3 Summary of Resultant Changes to Authorized HWRP

The following changes to the authorized HWRP would result if Alternative 3 were implemented:

- Elimination of levee between BMKV and SLC parcels
- Replacement of levee between HAAF and SLC parcels with an access berm
- Rerouting the authorized realignment of the NSD outfall pipeline
- Increase and change in location of high transitional marsh on the SLC parcel
- Repositioning of the breach location off the SLC parcel
- Placement of approximately 2.6 mcy less dredged material on SLC parcel.

Table 3-3
Estimated Post-Restoration Habitat Acreages at the Bel Marin Keys Expansion Site

Alternative	Subtidal	Tidal Mudflat	High Transitional Marsh	Tidal Marsh	Low Marsh	Seasonal Wetland	Freshwater Emergent Wetland	Open Water	Upland	**Total**
1	90	57	160	849	30	40	10	40	300	**1,576**
2, Revised	72	48	79	792	28	277	12	21	247	**1,576**
3	130	67	30	1,204	40	0	10	40	55	**1,576**

Notes:
Low marsh habitat = mean sea level to mean high water
Tidal mudflat habitat = mean lower low water to mean sea level (MSL ≈ 0.61 NGVD)
Subtidal = internal aquatic habitat below mean lower low water

4.0 COMPARISON OF ALTERNATIVES

Prior to the public review period, preliminary alternatives were evaluated and Alternative 2 was selected as the tentatively recommended plan. In response to comments received during the public review period, modifications were made to Alternative 2 and the revised alternative (Revised Alternative 2) was compared to Alternatives 1 and 3, as follows. Following the conclusion of the public review period, Revised Alternative 2 was selected as the preferred plan. A detailed description of Alternative 2, as envisioned prior to the public comment period, is presented in Appendix J.

4.1 COMPARISON OF PLAN FEATURES

All the action alternatives would require construction of new levees to protect adjacent properties from flooding. After site preparation, construction of levees, and placement of dredged material (if applicable), the levee between each cell and the bay would be graded down and breached, allowing tidal action on the site. Natural sedimentation, tidal action, and vegetation growth would then establish tidal salt marsh in each cell over a period of time.

Table 4-1 is a summary comparison of the activities proposed under each restoration alternative. Table 4-2 summarizes the total costs of the three alternatives. The differences consist chiefly of various features in the restoration plan for the BMKV parcel; the only potential design changes within the boundary of the authorized Hamilton Wetland Restoration Project are:

1) elimination of the levee between the SLC and BMKV parcels (all alternatives),
2) replacement of the levee between HAAF and BMKV with an access berm (all alternatives),
3) increase and change of location of high transitional marsh on the SLC parcel (all alternatives),
4) rerouting of the NSD outfall pipeline due to an expanded Pacheco Pond (all alternatives),
5) repositioning of the SLC breach location (Alternatives 2 and 3), and
6) reduction in volume of dredged material placement on the SLC parcel (Alternative 3).

Alternative 1 and Revised Alternative 2 rely on placement of clean dredged materials as fill to establish a grade close to the final desired condition, with natural processes responsible for development to final conditions over time. Alternative 3 relies on natural depositional and erosional processes for all phases of restoration development, except for a small (90-acre) area in the southeastern portion of the site, where dredged materials would be placed. The principle differences between the three alternatives are related to:

1) logistical and time considerations associated with dredged material placement, including construction of infrastructure for delivery and placement of dredged materials (Alternative 1 and Revised Alternative 2),
2) time to establish desired habitat conditions (all three alternatives),
3) the acreage of seasonal wetlands, ranging from 0 to 277 acres (all three alternatives),

4) the length of levees to be constructed (all three alternatives), and
5) habitat diversity (all three alternatives).

Use of dredged materials under Alternative 1 and Revised Alternative 2 would require extension of the dredged material delivery infrastructure required for the authorized HWRP. The new infrastructure would consist chiefly of dredged sediment delivery pipelines, as the off-loading station, off-loader pipeline, off-loader, and associated pumps would already be constructed as part of the authorized HWRP.

In comparison to the natural sedimentation approach of Alternative 3, the use of dredged materials to establish initial surface elevations in Alternative 1 and Revised Alternative 2 would greatly decrease the amount of time required to establish tidal marsh vegetation and develop the desired habitat types by comparison with time to establishment. Dredged material placement would thus provide more habitat in a shorter amount of time for those species that use salt marsh and associated aquatic habitats, as well as seasonal wetlands, freshwater marshes, and upland transition habitats.

The required levee construction efforts for Alternative 1 and Revised Alternative 2 are considerably greater than Alternative 3 (97,000 linear feet for Alternative 1, 94,800 linear feet for Revised Alternative 2 and 53,200 for Alternative 3, Table 4-1).

Use of natural sedimentation as the primary means of achieving marsh plain elevations precludes the development of seasonal wetlands under Alternative 3. Alternative 1 includes 40 acres of seasonal wetlands, and relies primarily on out-of-kind replacement of seasonal wetlands to achieve the no net loss of wetlands objective. Revised Alternative 2 includes 277 acres of seasonal wetlands, achieving 100% in-kind replacement for existing seasonal wetland habitat, and a combination of seasonal and tidal wetland habitat replacement for the agricultural wetlands.

The three alternatives differ in final habitat distribution. Alternative 3 has the least diverse habitat, with the highest acreage of tidal marsh habitat (however, this habitat will require up to 50 years to become established). Alternative 1 provides an intermediate range of habitat types, while Alternative 2 has the most balanced mix of habitat types.

The replacement, relocation and/or improvement of the NSD Outfall Pipeline and the associated Dechlorination Plant are authorized in the existing HWRP. However, in BMKV Alternatives 1, 2 and 3, the proposed expansion of Pacheco pond will likely require changing the alignment of a portion of the outfall pipeline. This will extend the outfall pipeline by approximately 500 lineal feet for Alternatives 1 and 3 and by approximately 400 lineal feet for Alternative 2. The BMKV portion of the HWRP will account for the additional cost of approximately $250,000 to $310,000 to accomplish the extended relocation around the enlarged portion of Pacheco Pond. These actions are compatible with the currently selected alternatives of replacing the outfall pipeline with a new plastic (HDPE) pipeline within the existing easement and relocating the Dechlorination Plant to the NSD treatment plants.

Table 4-1 Summary Comparison of Features Associated with the Expansion Project Action Alternatives

Project Alternatives	Alternative 1 – Dredged Material Placement with Enlarged Pacheco Pond	Revised Alternative 2 – Dredged Material Placement with Seasonal Wetlands and Enlarged Pacheco Pond	Alternative 3 – Natural Sedimentation with Enlarged Pacheco Pond
Earthwork			
New Levees	13,300 linear feet	21,000 linear feet	11,400 linear feet
Improved Levees/Berms	37,500 linear feet	36,400 linear feet	8,800 linear feet
Phase Containment Levees	30,400 linear feet	19,200 linear feet	6,500 linear feet
Internal Peninsulas/Berms	15,800 linear feet	18,200 linear feet	26,500 linear feet
Pilot Channel Excavation	2,100 linear feet	1,800 linear feet	1,200 linear feet
Dredged Material	13,200,000 cubic yards	13,800,000 cubic yards	1,200,000 cubic yards (a)
Time to Construct			
Site Preparation	2 years	2 years	2 years
Dredge Material Placement	10 years	10 years	1-2 years
Earthworks and Tidal Connections	1 year	1 year	0.5-1 year
Habitat Acreage			
Upland Transition	300 acres	247 acres	55 acres
Open Water	40 acres	21 acres	40 acres
Freshwater Emergent Wetland	10 acres	12 acres	10 acres
Seasonal Wetland	40 acres	277 acres	0 acres
High Transitional Marsh	160 acres	79 acres	30 acres
Tidal Marsh	849 acres	792 acres	1,204 acres
Low Marsh (b)	30 acres	28 acres	40 acres
Tidal Mudflat (c)	57 acres	48 acres	67 acres
Subtidal (d)	90 acres	72 acres	130 acres
Water Management			
Pacheco Pond: Modeled Change in Water Surface (10-year scenario, see Appendix B of Supplemental Final EIS/R)	–1.9 feet	–1.8 feet	–1.9 feet
Pacheco Pond: Modeled Change in Water Surface (100-year scenario; see Appendix B of Supplemental Final EIS/R)	-0.4 feet	-1.3 feet	-0.4 feet
Pacheco Pond: Change in Estimated Flood Storage Volume	+375 acre-feet	+650 acre-feet (in seasonal wetlands below 3/5' NGVD)	+375 acre-feet
Novato Creek: Change in Water Surface Elevation (10-year storm event)	No change	No change	No change
Novato Creek: Change in Invert Elevation Downstream of Breach	–0.5 feet	–0.5 feet	No change
Time to Establishment of Target Elevations			
Mud Flat	0 years	0 years	5 years
Low Marsh	0 years	0 years	15 years
Mid-High Marsh	10 years	10 years	40 years

Relocation of NSD facility	Authorized HWRP included relocation of dechlorination plant and retrofit/replacement of existing pipeline. Alt. 1 includes extension of new pipeline around east side of Pacheco Pond, with access road/berm	Authorized HWRP included relocation of dechlorination plant and retrofit/replacement of existing pipeline. Alternative includes access road/berm and extension of new pipeline around east side of Pacheco Pond	Authorized HWRP included relocation of dechlorination plant and retrofit/replacement of existing pipeline. Alt. 3 includes extension of new pipeline around east side of Pacheco Pond, with access road/berm.

(a) Represents fill associated with placement of dredged material on 90 acres of the southeast corner of the SLC parcel
(b) MSL–MHW
(c) MLLW–MSL (MSL ≈ 0.61 NGVD, includes 2 acres of existing tidal mudflat on property)
(d) MLLW and below

Table 4-2 Summary of Costs (2002 Price Levels)

	No- Action	Alt 1	Revised Alt 2	Alt 3
Lands and Damages	$0	$19,438,225	$19,438,225	$19,438,225
Relocations	$0	$750,000	$324,765	$750,000
Levees and Floodwalls	$0	$38,053,800	$44,082,158	$19,420,200
Dredged Material Placement	$0	$82,085,000	$96,316,103	$0
Recreation Features	$0	$192,900	$181,483	$181,483
Planning, Engineering & Design (PE&D)	$0	$11,260,000	$11,260,000	$11,260,000
E&D/Construction Management (S&A)	$0	$11,118,920	$11,118,920	$11,118,920
Total Implementation Cost	**$0**	**$162,898,845**	**$182,721,654**	**$62,168,828**
Interest During Construction	$0	$25,603,170	$28,718,764	$9,771,211
Total Investment Cost	**$0**	**$188,502,015**	**$211,440,418**	**$71,940,039**
Average Annual Cost (@5.875 %; excluding O&M)	$0	$11,751,216	$ 13,181,196	$ 4,484,742
OMRR&R Costs	$0	$525,000	$ 525,000	$525,000
Total Annual Cost	**$0**	**$ 12,276,216**	**$ 13,706,196**	**$ 5,009,742**
Local Government Finance-State of California (Total Project First Cost)	$0	Restoration $28,400,000 Recreation $96,450 Total $28,500,000	Restoration $33,300,000 Recreation $90,741 Total $33,400,000	Restoration $21,700,000 Recreation $90,741 Total $21,800,000

4.2 System of Accounts

4.2.1 Methodology

The Corps' Principles and Guidelines for the planning process have established four specific categories or "accounts" which are used to facilitate evaluation and display the effects of alternative plans. These accounts are: National Economic Development (NED), Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE). These four accounts encompass all significant effects that a plan might have on the human environment

as required by the National Environmental Policy Act of 1969 (NEPA) and encompass social well being as required by Section 122 of the Flood Control Act of 1970.

The NED account identifies beneficial and adverse effects on the nation's economy. Beneficial effects in the NED account are increases in the economic value of the national output of goods and services from a plan and are expressed in monetary units. For an ecosystem restoration project such as the expansion of HWRP to include BMKV, the National Ecosystem Restoration (NER) account is used in place of the NED account. The Corps' objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER). Contributions to national ecosystem restoration (NER outputs) are increases in the net quantity and/or quality of desired ecosystem resources. Measurement of NER is based on changes in ecological resource quality as a function of improvement in habitat quality and/or quantity and expressed quantitatively in physical units or indexes. In this GRR, the outputs of proposed alternatives are ecosystem restoration, which are quantified in non-monetary units. Therefore, a NED plan is not identified in this study. ER-1105-2-100 states "Single purpose ecosystem restoration plans shall be formulated and evaluated in terms of their net contributions to increases in ecosystem value (NER) outputs, expressed in non-monetary units...". Each of these resource accounts and the results of the evaluation are described below.

4.2.2 National Ecosystem Restoration (NER)

The NER plan is identified by the Federal government as the plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective. It is cost-effective and justified to achieve the desired level of outputs. The NER plan is the restoration alternative that the Federal government will recommend in the Draft General Reevaluation Report, unless an exemption from the NER is required, as with a Locally Preferred Plan. The Federal government will cost share up to the price of the NER plan. For ecosystem restoration projects, the Federal share is 65%, while the non-Federal share is 35%. If beneficial reuse of dredged material is achieved, as in Alternative 1 and Revised Alternative 2, the Federal share increases to 75%, while the non-Federal share decreases to 25%. In accordance with the US Army Corps Policy Guidance Letter 59, the cost of justified and approved recreation features will be cost shared at 50% Federal and 50% non-Federal, provided the Federal cost is not increased by more than 10%. The NER plan identified by this GRR is Alternative 2, Dredged Material Placement with Seasonal Wetlands. The rationale leading to this selection is described in the following sections and summarized in Section 4.6.

4.2.3 Environmental Quality (EQ)

Beneficial effects in the EQ account are favorable changes in the ecological, aesthetic, and cultural attributes of the natural and cultural environment. For the expansion of HWRP to include BMKV, these include an increased value of wetland habitat and overall wildlife habitat. Adverse effects in the EQ account are unfavorable changes in the ecological, aesthetic, and cultural attributes of these same resources. As described in the Supplemental FEIS/R, there is a potential increase in methylmercury formation as a result of ecosystem restoration at the HWRP expansion to BMKV.

Table 4-3 Summary of Environmental Quality Account

Environmental attributes	Alternatives			
	No Action	1	2	3
Ecological attributes (includes physical and biological aspects of ecosystems)				
Water quality	No impact	Potential increase in methylmercury formation	Potential increase in methylmercury formation	Potential increase in methylmercury formation
Air quality	No impact	Minor construction-related impacts	Minor construction-related impacts	Minor construction-related impacts
Overall wildlife Habitat value	No impact	Significant positive effect	Significant positive effect	Significant positive effect
Tidal wetland Habitat value	No impact	Large positive effect	Large positive effect	Large positive effect
Seasonal Wetland habitat Value	No impact	Minor negative effect	Moderate positive effect	Moderate negative effect
Upland habitat Value	No impact	Moderate loss	Moderate loss	Large loss
Cultural environment				
Cultural Resources	No impact	Potential disturbance of unknown sites	Potential disturbance of unknown sites	Potential disturbance of unknown sites
Aesthetic environment				
Noise	No impact	Minor construction-related impacts	Minor construction-related impacts	Minor construction-related impacts
Visual Resources	No impact	Minor temporary impacts; long-term change in views from BMK community	Minor temporary impacts; long-term change in views from BMK community	Minor temporary impacts; long-term change in views from BMK community

4.2.4 Other Social Effects (OSE)

Other social effects involve urban and community impacts such as employment distribution, potential displacement of businesses, and local government's fiscal condition, as well as life, health, and safety effects. For the Hamilton Wetland Restoration Project proposed expansion to include Bel Marin Keys, these impacts are not directly measurable; however, the restoration of wetlands will improve the quality of community life for residents near the restored site and regionally by increasing the value of wildlife habitat and increasing recreational access to the Bay Trail. There is a minor potential increase to offsite fishing and hunting as the value of wildlife habitat is increased.

4.2.5 Regional Economic Development (RED)

The Regional Economic Development (RED) account is intended to illustrate the effects that the study alternatives would have on regional economic activity; specifically, regional income and regional employment. The comparison of possible effects that the plans would have on these resources is shown in Table 4-4.

Table 4-4 Other Social Effects and Regional Economic Development Accounts

I. Regional Economic Development	No Action	Alternative 1	Alternative 2	Alternative 3
Employment/Labor Force	No change expected	12 year temporary increase in construction-related employment	12 year temporary increase in construction related employment	5 year temporary increase in construction-related employment
Business and Industrial Activity	N/A	*Potential increase in shipping efficiencies given the lack of dredging delays	*Potential increase in shipping efficiencies given the lack of dredging delays	N/A
Local Government Finance-State of California (Total Project First Cost)	N/A	Restoration $28,400,000 Recreation $96,450 Total $28,500,000	Restoration $33,300,000 Recreation $90,741 Total $33,400,000	Restoration $21,700,000 Recreation $90,741 Total $21,800,000
II. Other Social Effects				
Public Health and Safety	N/A	Improved well being due to enhanced habitat	Improved well being due to enhanced habitat	Improved well being due to enhanced habitat
Public Facilities and Services	N/A	N/A	N/A	N/A
Recreation and Public Access	No change expected	Increased recreational opportunities from enhanced habitat	Increased recreational opportunities from enhanced habitat	Increased recreational opportunities from enhanced habitat
Traffic/Transportation	No change expected	No change expected	No change expected	No change expected
Man Made Resources	N/A	N/A	N/A	N/A
Natural Resources	No change anticipated	Increased special-status species habitat; Restoration of healthy, diverse wetlands; Potential minor increase in offsite fishing and hunting.	Increased special-status species habitat; Restoration of healthy, diverse wetlands; Potential minor increase in offsite fishing and hunting.	Increased special-status species habitat; Restoration of healthy, diverse wetlands; Potential minor increase in offsite fishing and hunting.

*Note: The potential increase in shipping efficiencies will have more of a national than regional effect, which would normally be included in the NED account. However, as the NED account is not used in ecosystem restoration, this effect was included in the RED account.

4.3 INCREMENTAL ANALYSIS OF PROJECT FEATURES

Because the Hamilton Wetland Restoration Project is already authorized, the economic justification of HWRP was not reanalyzed. Nevertheless, the federal interest in the currently authorized HWRP was reestablished through the BMKV incremental cost analysis because both the implementation design and general output features of the HWRP and the BMKV expansion are equivalent.

4.3.1 Purpose of the Incremental Analysis

This general reevaluation study examines the alternatives using a number of analyses and evaluation criteria. While there is no generally accepted method for quantifying environmental benefits in monetary terms, two decision-making tools have helped planners decide how to allocate limited resources more effectively. *Cost effectiveness* analysis helps filter out plans with equivalent output levels that are more expensive. *Incremental analysis* allows planners to progressively proceed through available levels of output and asks if the next level of additional outputs is worth its additional cost. Another analysis that must be performed is an examination of the incremental cost-efficiency of different potential measures to create fish and wildlife habitat value. This analysis is normally performed on measures that mitigate the impacts of a project on fish and wildlife habitat. In an environmental restoration study, the incremental cost analysis instead examines the cost-efficiency of the environmental restoration alternatives themselves.

In an incremental analysis, each possible combination of increments is examined for cost-efficiency. As cost-efficiency in producing fish and wildlife habitat value is only one of the criteria used to evaluate alternatives, the conclusions of this analysis are not the sole determinant of which alternatives receive detailed consideration in the feasibility study, nor which alternative is selected as the preferred plan.

This section analyzes the cost-efficiency of these alternatives in achieving the planning objective of wetland restoration. Some of these alternatives are not responsive to other planning objectives, but are included here for purposes of comparison.

4.3.2 Use of the Habitat Evaluation Procedure Results

A Habitat Evaluation Procedure (HEP) study to determine HWRP impacts on wildlife habitat was performed by the U.S. Fish and Wildlife Service (FWS). This study looked at impacts on all habitats that either currently exist or would be created under the alternatives. In a HEP study, individual wildlife species serve as surrogates for entire habitats, with impacts on these *evaluation species* used to indicate impacts on the habitats they inhabit.

A HEP study normally fulfills two functions in a Corps flood damage reduction or navigation feasibility study where existing habitat must be protected. First, it determines impacts on various existing wildlife habitats to determine mitigation requirements. Second, it is used by the Corps to determine the cost-effectiveness and efficiency of different mitigation increments. The incremental analysis for mitigation included in a feasibility report or general reevaluation report compares the cost and output of each mitigation increment to determine the optimal level of investment in mitigation. However, this approach has difficulties when applied to an ecological restoration study such as this one, as HEP does not differentiate between Habitat Units (HUs) of

a common species and HUs of a rare species, nor between the value of common and scarce habitats, nor does it consider the ecological role of a species or habitat outside of the project site itself, that is, in the local or regional context.

In an ecosystem restoration project, the objective is to improve and create habitat; as a result, mitigation should not be required and the mitigation-oriented HEP is instead used to determine the output of each alternative. In the case of the Hamilton wetland restoration study, the FWS HEP showed relatively small overall gains in HUs from using dredged material to accelerate the rate of marsh formation. This is because as tidal marsh develops, it replaces mudflats which themselves have habitat value. Accelerating the rate of tidal marsh development merely accelerates the rate at which this tradeoff occurs, yielding little increase in total habitat units.

For this reason, the standard incremental mitigation analysis for this study has been modified to instead measure the cost-effectiveness and cost-efficiency of project increments in creating tidal salt marsh and other wetlands. Tidal marsh habitat is of particular concern in the San Francisco Estuary (San Francisco, San Pablo, and Suisun Bays) due to the magnitude of historic losses of this habitat type, the high ecological value of this habitat, and its particular importance to endangered species (the California clapper rail and the salt marsh harvest mouse). The non-tidal wetlands evaluated in the HEP also have high ecological importance, have suffered major losses in the region and are a priority for restoration efforts.

To evaluate the habitat benefits of using dredged material, the 12 evaluation species/habitat combinations used in the FWS HEP for the HWRP were narrowed down to 5 combinations: salt marsh rail guild/tidal salt marsh; egret guild/tidal salt marsh; wintering mallard/seasonal wetland; desert cottontail/seasonal wetland; and wintering mallard/non-tidal emergent marsh. These are the species/habitat combinations within the HEP that would particularly benefit from wetland restoration. Limiting the analysis to these combinations allows the cost-effectiveness and cost-efficiency of the alternatives in creating wetland habitats to be determined.

The exclusion of the other species/habitat combinations was made knowing that some of them would experience net losses. However, trading off these species and their habitats for species and habitats deemed much more important has been endorsed (within certain limits) by the non-federal sponsor and the resource agencies, and in fact is an unavoidable consequence of implementing any of the action alternatives.

Existing and future wetland habitats on the BMKV parcel were assigned habitat values (habitat suitability indices) based upon the results of the HWRP HEP, with adjustments to reflect differences in habitat evolution. Cumulative and average annual habitat units were then calculated based upon these habitat suitability indices, habitat acreages, and construction phasing.

4.3.3 Cost Effectiveness/Incremental Cost Analysis

4.3.3.1 Introduction

When a common measurement unit for comparing *non-monetary* project benefits with *monetary* project costs does not exist, a traditional benefit-cost analysis cannot be performed to evaluate

the project alternatives and identify the most "optimal" plan – the plan that maximizes net benefits. For the Bel Marin Keys (BMKV) Restoration Project, where project costs are measured in dollars and project benefits are measured in habitat units, cost effectiveness and incremental cost analyses (CEA/ICA) were used as an alternative approach to evaluate plans.

Cost effectiveness analysis and incremental cost analysis are valuable planning tools that assist in the decision making process. For Bel Marin Keys, CEA/ICA allowed for the examination of environmental outputs, the identification of "best buy" plans, and the comparison of the relative cost effectiveness of the "best buy" plans. The analysis, the assumptions used in the analysis, and the results are explained below.

4.3.3.2 Key Assumptions and Data Input

Key assumptions and data input are presented in Table 4-5.

Table 4-5 Key Assumptions and Data

	Alternative 1	Revised Alternative 2	Alternative 3
Total Investment Cost[1] (BMKV portion only)	$188,502,015	$211,440,418	$71,940,039
Total Implementation Cost	$162,898,845	$182,721,654	$62,168,828
Interest During Construction	$25,603,170	$28,718,764	$9,771,211
OMRR&R Costs	$525,000	$525,000	$525,000
Construction Period[2]	5 yrs	5 yrs	5 yrs
Output (AAHU)[3]	426	526	272
Average Annual Cost [4]	$12,276,216	$13,706,196	$5,009,742

[1] Total investment costs include total implementation costs and interest during construction (IDC).
[2] The construction period for each alternative is 5 years, at which point project benefits begin to accrue.
[3] Project outputs are expressed as average annual habitat units (AAHU), which represent the average annual habitat units of wetlands (tidal and non-tidal marsh) produced by a plan.
[4] The study life is 50 years; the discount rate is 5.875 percent; costs reflect October 2002 prices.

4.3.3.3 Step 1 – Eliminating Non-Cost Effective Plans

For the Bel Marin Keys Restoration Project, the alternatives were first ordered by increasing costs. Alternative 3 (BMK3) has the lowest average annual costs at $5,009,742, followed by Alternative 1 (BMK1; $12,276,216) and Revised Alternative 2 (BMK2; $13,706,796). The "no action" plan has zero costs. Table 4-6 displays the plans and their respective costs.

Table 4-6 Array of Alternatives Sorted by Increasing Costs

Bel Marin Keys Alternative	Average Annual Cost ($)
No Action Plan	$0
BMK3 (Natural Sedimentation with Enlarged Pacheco Pond)	$5,009,742
BMK1 (Dredged Material Placement with Enlarged Pacheco Pond)	$12,276,216
BMK2 (Dredged Material Placement with Seasonal Wetland and Enlarged Pacheco Pond)	$13,706,196

The next step was to eliminate all of the non-cost effective plans. A plan is considered to be non-cost effective if there exists another plan that either 1) produces the same level of output at less cost, 2) produces a greater level of output at the same cost, or 3) produces a greater level of output at less cost. As Table 4-7 reveals, none of the alternatives could be considered cost-ineffective; that is, when comparing the plans with one another, none of them met any of the three criteria of a non-cost effective plan, as outlined above. Thus, all three alternatives remained in the analysis.

Table 4-7 1st Iteration – Eliminating the Non-Cost Effective Plan(s)

Bel Marin Keys Plan	Average Annual Cost ($)	Output (Average Annual Habitat Units)
No Action Plan	$0	0
BMK3 (Natural Sedimentation with Enlarged Pacheco Pond)	$5,009,742	272
BMK1 (Dredged Material Placement with Enlarged Pacheco Pond)	$12,276,216	426
BMK2 (Dredged Material Placement with Seasonal Wetlands and Enlarged Pacheco Pond)	$13,706,196	526

4.3.3.4 Step 2 – Identifying the "Best Buys" or Least Incremental Cost Alternatives

The incremental cost analysis proceeded by treating the "no action" plan as the first increment (or baseline) and then using this baseline to calculate incremental costs, incremental outputs and incremental cost per unit of output for each of the remaining two alternatives. Next, the plan that is the "best buy" was then identified; this is the plan that has the lowest incremental cost per unit of output and which is the most cost efficient (i.e., it offers the "biggest bang per buck"). Using the "no action" alternative as the baseline, Table 4-8 reveals that Alternative 3 is the most cost efficient of the remaining alternatives, having an incremental cost of $18,418 per unit of output (compared to a cost of $28,817 per unit of output for Alternative 1 and a cost of $26,057 per unit of output for Revised Alternative 2).

While Alternative 1 and Revised Alternative 2 are still cost effective, Alternative 3 is the best buy and is the next best alternative that can be chosen above the "no action" plan. Alternative 3, then, serves as the baseline for the next step.

Table 4-8 2nd Iteration – Identifying the Best Buy Plan

Bel Marin Keys Plan	Average Annual Cost ($)	Output (Average Annual Habitat Units)	Incremental Cost ($)	Incremental Output (Average Annual Habitat Units)	Incremental Cost Per Unit of Output ($/AAHU)
No Action Plan (baseline)	$0	0	---	---	---
BMK3 (Natural Sedimentation with Enlarged Pacheco Pond)	$5,009,742	272	$5,009,742	272	$18,418
BMK1 (Dredged Material Placement with Enlarged Pacheco Pond)	$12,276,216	426	$12,276,216	426	$26,057
BMK2 (Dredged Material Placement with Seasonal Wetlands and Enlarged Pacheco Pond)	$13,706,196	526	$13,706,196	526	$28,817

4.3.3.5 Step 3 – Recalculating Incremental Costs, Incremental Outputs, and Incremental Costs Per Unit of Output Using the Alternative 3 Plan as the Baseline

Incremental costs, incremental outputs, and incremental cost per unit of output were then recalculated for Alternative 1 and Revised Alternative 2 using the "best buy" alternative (Alternative 3) as the baseline. As Table 4-9 shows, the incremental cost, incremental output, and incremental cost per unit of output for Alternative 1 are $7,266,474, and $47,185, respectively; for Revised Alternative 2 they are $8,696,454, and $34,238, respectively. In other words, each of the additional 154 average annual habitat units produced by Alternative 1 beyond the 272 AAHUs produced by Alternative 3 costs approximately $47,185; similarly, each of the additional 254 AAHUs produced by Revised Alternative 2 beyond the 272 AAHUs produced by Alternative 3 costs approximately $34,238.

Of the two plans (Alternative 1 and Revised Alternative 2), Revised Alternative 2 is considered a "best buy" because it has a lower incremental cost per unit of output than Alternative 1. That is, from an incremental cost perspective, Alternative 1 does not provide as much "bang per buck" as Revised Alternative 2. At this point, then, Alternative 1 was removed from further analysis. (However, since Alternative 1 is cost-effective, it still could presumably be chosen as the preferred plan. This decision would have to be made using information not provided by the CEA/ICA.)

Table 4-9 3rd Iteration – Recalculate Incremental Costs, Incremental Outputs, and Incremental Costs Per Unit of Output Using the BMK3 Plan as the Baseline; ID Plan with Lowest Incremental Cost Per Unit and Eliminate Plans with Both Higher Incremental Costs and Lower Incremental Outputs

Bel Marin Keys Plan	Average Annual Cost ($)	Output (Average Annual Habitat Units)	Incremental Cost ($)	Incremental Output (Average Annual Habitat Units)	Incremental Cost Per Unit of Output ($/AAHU)
No Action Plan	$0	0	---	---	---
BMK3 -- baseline -- (Natural Sedimentation with Enlarged Pacheco Pond)	$5,009,742	272	$5,009,742	272	$18,418
~~BMK1 (Dredged Material Placement with Enlarge Pacheco Pond)~~	~~$12,276,216~~	~~426~~	~~$7,266,474~~	~~154~~	~~$47,185~~
BMK2 (Dredged Material Placement with Seasonal Wetlands and Enlarged Pacheco Pond)	$13,706,196	526	$8,696,454	254	$34,238

4.3.3.6 Conclusion and the Final Array of Alternatives

Table 4-10 displays the final array of alternatives for the Bel Marin Keys Restoration Project along with their respective cost and output information.

Table 4-10 Final Array of Best Buys

Bel Marin Keys Plan	Average Annual Cost ($)	Output (Average Annual Habitat Units)	Incremental Cost ($)	Incremental Output (Average Annual Habitat Units)	Incremental Cost Per Unit of Output ($/AAHU)
No Action Plan	$0	0	---	---	---
BMK3 (Natural Sedimentation with Enlarged Pacheco Pond)	$5,009,742	272	$5,009,742	272	$18,418
BMK2 (Dredged Material Placement with Seasonal Wetlands and Enlarged Pacheco Pond)	$13,706,196	526	$8,696,454	254	$34,238

Cost effectiveness and incremental cost analyses are valuable planning tools to assist in the decision-making process. However, unlike in a traditional benefit-cost analysis, in which a unique plan can be identified as the National Economic Development (NED) plan, CEA-ICA will not identify a unique solution for plan selection.

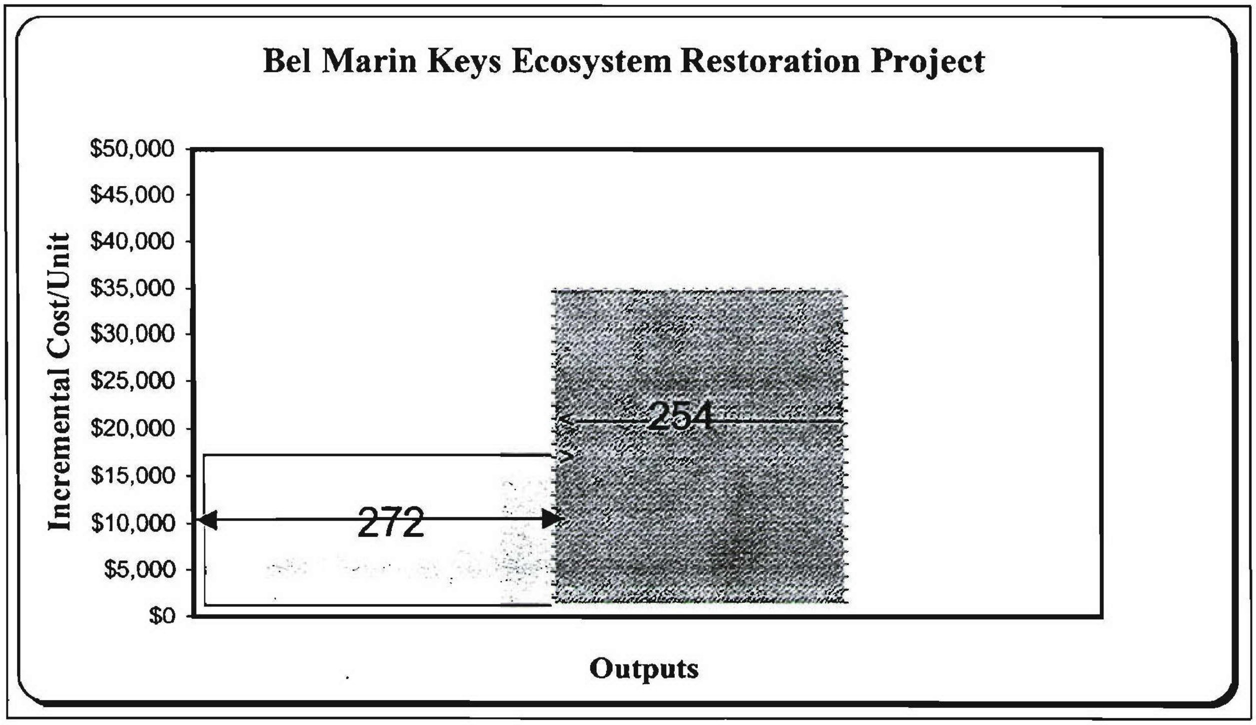
In the case of the Bel Marin Keys Restoration Project, Alternative 3 is one of the "best buys". This is the plan that offers the "biggest bang per buck" at its given level of output. Revised Alternative 2 is also a "best buy". However, the additional 254 average annual habitat units provided by this alternative come at a much higher incremental cost per unit ($34,238 vs. $18,418/unit of output for Alternative 3).

Typically, when an alternative's incremental cost per unit of output increases relatively sharply in contrast to the incremental cost per unit of output for the alternative preceding or following it, a "breakpoint" is revealed in the incremental cost curve. This "spike" in the incremental cost curve can serve as a potential decision point by focusing on the question, "Is it worth it?" and by providing decision makers with reasons to question the "worth" of the additional incremental cost.

So, if it is decided that each of the 272 average annual habitat units provided by Alternative 3 is worth $18,418, then it must be decided if the additional 254 average annual habitat units provided by Revised Alternative 2 is worth $34,238. Ultimately, a designation of the National Ecosystem Restoration (NER) Plan requires that "decision makers base subjective judgments about the value of the output being produced on additional information generated outside the framework of CEA/ICA" (IWR Report #95-R-1).

Figure 4-1 displays the incremental cost per unit of output for Alternative 3 and Revised Alternative 2, respectively.

Figure 4-1



4.3.4 Relationship of the Incremental Analysis Conclusions to the Study Alternatives

The incremental analysis determined that Revised Alternative 2 and Alternative 3 are most cost-efficient for their level of output of tidal marsh habitat. Alternative 1 was determined not to be cost-efficient for this output. However, other criteria are used in evaluating and screening potential alternatives and are applied here to the alternatives considered.

4.4 Incremental Analysis of Access Features (Recreation)

The national economic development (NED) benefit evaluation procedures contained in ER1105-2-100 (Corps' Planning Guidance Notebook), Appendix E, Section VII describe various methods of evaluating the beneficial and adverse NED effects of project recreation: travel cost method (TCM), contingent valuation method (CVM), and unit day value (UDV) method.

For this study, the unit day value (UDV) method was chosen to calculate the recreational benefit of providing access features and a trail along the Bel Marin Keys restoration site. The UDV method relies on expert or informed opinion and judgment to approximate the average willingness to pay of users of Federal or Federally assisted recreation resources. Under the UDV method, planners select a specific value from the range of values provided annually by HQUSACE. This selected value (or "score") is then converted to dollar units and multiplied by the estimated annual use of the project life to generate a monetary value of the recreational opportunity.

For evaluation purposes, two categories of outdoor recreation days, "general" and "specialized", must first be considered. "General" refers to a recreation day involving primarily those activities that are attractive to the majority of outdoor users and that generally require the development and maintenance of convenient access and adequate facilities. "Specialized" refers to a recreation day involving those activities for which opportunities in general are limited, intensity of use is low, and a high degree of skill, knowledge, and appreciation of the activity by the user may often be involved.

Because other recreational opportunities are abundant and accessible to those with novice ability, the recreation was classified as "general". And while there are unique opportunities to witness endangered species, most of the proposed recreational activities for the Bel Marin Keys path include hiking, biking, photography, and education.

The list of criteria put forth by HQUSACE includes quality, relative scarcity, ease of access and aesthetic features. The guidelines and point schedules appear in Table 4-11 while the monetary conversion units appear in Table 4-12.

Table 4-11 Guidelines for Assigning Points for General Recreation

Criteria	Judgment Factors				
Recreation experience[1] Total Points: 30 Point Value:	Two general activities[2] 0-4	Several general activities 5-10	Several general activities: one high quality value activity[3] 11-16	Several gen'l act: more than one high qual high activity 17-23	Numerous high quality value activities: some general activities 24-30
Availability of Opportunity[4] Total Points: 18 Point Value	Several within 1 hr. travel time: a few within 30 min. travel time 0-3	Several within 1 hr. travel time: none within 30 min. travel time 4-6	One or two within 1 hr. travel time; none within 45 min. travel time 7-10	None within 1 hr. travel time 11-14	None within 2 hr. travel time 15-18
Carrying Capacity[5] Total Points: 14 Point Value:	Minimum facility for development for public safety and health 0-2	Basic facility to conduct activity(ies) 3-5	Adequate facilities to conduct without deterioration of the resource of activity experience 6-8	Optimum faculties to conduct activity at site potential 9-11	Ultimate facilities to achieve intent of selected alternative 12-14
Accessibility Total Points: 18 Point Value:	Limited access by any means to site or within site 0-3	Fair access, poor quality roads to site; limited access within site 4-6	Fair access, fair road to site, fair access, good roads within site 7-10	Good access, good roads to site; fair access, good roads within site 11-14	Good access, high standard road to site; good access within site 15-18
Environmental Total Points: 20 Point Value	Low aesthetic factors[6] that significantly lower quality[7] 0-2	Average aesthetic Quality; factors exists that lower quality to minor degree 3-6	Above average aesthetic quality; any limiting factors can be reasonably rectified 7-10	High aesthetic quality; no factors exist that lower quality 11-15	Outstanding aesthetic quality; no factors exist that lower quality 16-20

[1] Value for water-oriented activities should be adjusted if significant seasonal water level changes occur.
[2] General activities include those that are common to the region and that are usually of normal quality. This includes picnicking, camping, hiking, riding, cycling, and fishing and hunting of normal quality.
[3] High quality value activities includes those that are not common to the region and/or Nation, and that are usually of high quality.
[4] Likelihood of success at fishing and hunting.
[5] Value should be adjusted for overuse.
[6] Major aesthetic qualities to be considered include geology and topography, water and vegetation.
[7] Factors to be considered to lowering quality include air and water pollution, pestes, poor climate, and unsightly adjacent areas.

Recreational experience (0-30)- The recreation path is high in the category of several general activities. It contains more than one high quality level activity---hiking and biking would be the most common general activities, specialized nature photography and education regarding

ecosystem restoration and dredged material reuse are the other high quality value activities. **A score of 17 was assigned.**

<u>**Availability of Opportunity (0-18)**</u> There are no other similar sites for education or photography within a 2-hour travel distance. There are other walking and biking opportunities, but not endangered species habitat or educational opportunities for beneficial reuse. **A score of 15 was assigned.**

<u>**Carrying capacity (0-14)**</u>: There are adequate facilities, not outstanding, to conduct activities at site. **A score of 8 was assigned.**

<u>**Accessibility (0-18)**</u>: The area has excellent access from the road to the site.
A score of 17 was assigned.

<u>**Environmental (0-20):**</u> The area has a high but not outstanding aesthetic quality and no factors exist that lower quality. **A score of 15 was assigned.**

<u>**Total:**</u> **17+15+8+17+15 = 72 points**

Converting the total score of 72 to dollar values (see Table 4-12), results in a unit day value of $7.02 for each recreational visitor.

Table 4-12 Conversion of Points to Dollar Values

Point Values	General Recreation Values	General Fishing and Hunting Values	Specialized Fishing and Hunting Values	Specialized Recreation Values other than Fishing & Hunting
0	$2.82	$4.06	$19.75	$11.46
10	$3.35	$4.58	$20.28	$12.17
20	$3.70	$4.94	$20.63	$13.05
30	$4.23	$5.47	$21.16	$14.11
40	$5.29	$6.00	$21.69	$14.99
50	$6.00	$6.52	$23.80	$16.93
60	$6.52	$7.23	$25.92	$18.69
70	$6.88	$7.58	$27.51	$22.57
80	$7.58	$8.11	$29.62	$26.27
90	$8.11	$8.29	$31.74	$29.98
100	$8.46	$8.46	$33.50	$33.50

<u>Source</u>: Economic Guidance Memorandum 01-01, Unit Day Values for Recreation, FY 2001

Estimated Use

Based on conversations with Laura Thompson of the San Francisco Bay Trail and information from the Marin County Bicycle and Pedestrian Master Plan completed by Alta Consulting in 2000, trails in similar surroundings have an estimated usage of 250,000 visitors per year. However, after further discussion with Alta Consulting, it was estimated that the HWRP trail would generate 200 visitors per day or 73,000 annually. This figure is very reasonable due to (1) its proximity to the populous Bay Area; (2) the large number of tourists; (3) accessibility; and (4) the favorable climate and lack of seasonal variation.

Recreation Value

Multiplying the unit day value of $7.02 by 73,000 annual recreational users yields a total of $512,460. The cost of the Bay Trail, parking lot, restrooms and display boards in excess of $512,460 is not justified and would be the sole responsibility of the non-Federal sponsor.

4.5 ASSOCIATED EVALUATION CRITERIA

The alternative plans were evaluated against the specific criteria (completeness, effectiveness, efficiency, and acceptability) presented in US Army Corps of Engineers Regulation ER 1105-2-100. The four criteria described below are used to evaluate project plans under Federal guidelines. These criteria are also used to narrow the alternatives to a recommended plan.

4.5.1 Completeness

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure realization of the planned effects. This criterion assures that all measures required to achieve the desired outputs are included in the plan, or at least addressed.

All the action alternatives are complete conceptual tidal marsh restoration plans. None of these alternatives require any additional substantial features to accomplish the study objectives. The No Action Plan is not complete because it does not address the identified problems and opportunities

4.5.2 Effectiveness

Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities. Effectiveness is a measure of a plan's ability to achieve the desired output and can be evaluated as follows:

- Plans must represent sound, safe acceptable engineering solutions to the problems and needs.
- Plans must be technically achievable and cannot contain obstructions that would prevent accomplishment of the desired output.
- Plans must be realistic and state-of-the-art. However, they must not rely on future research and development of key components.

Wetland and Endangered Species Habitat Restoration
All the action alternatives are effective to varying degrees in restoring wetland habitat and its value for endangered species. Revised Alternative 2 is the most effective, as it restores more of this habitat than Alternative 1, and restores this habitat in less time than Alternative 3. Revised Alternative 2 also provides the greatest diversity of habitat. Ecosystems are most healthy and sustainable, and most valuable to animals when they contain a range of habitat types covering a range of elevations. An important component of tidal marsh habitat is the presence of higher elevation areas for animals such as the harvest mouse to retreat to during high tide events. Alternative 3 does not allow for the creation of seasonal wetlands and limits the amount of upland habitat and high tide refugia that can be created. Considering the diversity of habitat, Revised Alternative 2 adds value that is not provided by either Alternative 1 or 3. The no-action alternative is not effective in increasing these habitats.

Beneficial Reuse of Dredged Material
As described in this document, the Long-Term Management Strategy for dredged material in the San Francisco Bay Area has a goal of 40% upland reuse of dredged sediment. The Corps has formally adopted the LTMS Final Management Plan. The beneficial reuse of dredged sediment at BMKV would substantially increase the capacity for upland reuse, and would assure the availability of upland reuse opportunities into the future. It would thus support the long-term success of the LTMS. It is important to recognize that these benefits can be achieved with fewer environmental impacts because the off-loader facilities (including the off-loading station and off-loader pipeline and pumps) will already have been constructed for the authorized project. Allowing beneficial reuse at the BMKV parcel would lead to extended use of facilities that would already be constructed. Thus, Alternative 1 and Revised Alternative 2 rate more favorably than Alternative 3, with Revised Alternative 2 being slightly more effective because it provides slightly more upland disposal capacity. The no-action alternative and Alternative 3 are not effective in furthering this objective because they do not provide for upland disposal of dredged material.

Overall Effectiveness
Revised Alternative 2 is most effective overall in achieving the study objectives of wetland restoration (including endangered species habitat restoration), and beneficial reuse of dredged material.

4.5.3 Efficiency

Efficiency can be examined in several different ways for this project. Economic efficiency measures the amount of project outputs (such as habitat units, acres of tidal marsh, or upland dredged material disposal capacity) per unit of economic cost. Ecological efficiency measures the amount of project output per unit of ecological input.

Economic Efficiency
As explained above in the incremental analysis, the most economically efficient study alternative in terms of creation of habitat units is Alternative 3, with an incremental cost of $17,752 per habitat unit over the No-Action Plan. Revised Alternative 2 and Alternative 1 have higher incremental costs, but are cost-efficient for their levels of output ($25,912 and $29,278 average cost per habitat unit, respectively).

Alternative 1 has a total implementation cost of $162,898,845 and a dredged material placement capacity of 13.2 mcy ($12.34/cy) while Revised Alternative 2 has a total implementation cost of $182,721,645 and dredged material placement capacity of 13.8 mcy ($13.24/cy). Alternatives 3 and the no-action alternative do not provide significant dredged material disposal capacity. Alternative 1 is therefore the most efficient at meeting the objective of providing capacity for upland disposal of dredged material, as stated in the LTMS program and other plans, as it provides a slightly lower unit cost for upland disposal.

The cost-efficient disposal of dredged material created by using dredged material in Alternative 1 and Revised Alternative 2 can be viewed as a free benefit of accelerated wetland restoration. Therefore, considering both tidal marsh habitat creation and dredged material reuse, both Alternative 1 and Revised Alternative 2 can be considered to be economically efficient.

Ecological Efficiency
Ecological efficiency is harder to quantify. One way to measure it is to measure the amount of desired habitat value created per acre of habitat created. Since tidal and seasonal wetlands are the primary habitat objective of this project, Table 4-13 shows the total average annual habitat units for all wetlands per acre of wetland created. This table shows that alternatives using dredged material produce more habitat value (over the 50-year evaluation period) per acre of wetland ultimately created. This result is expected since the HEP assumes that tidal marsh would form faster with the use of dredged material.

All the action alternatives would increase the total amount of habitat on the site by converting current agricultural lands to wildlife habitat. These alternatives would also replace common grassland habitat with scarce tidal marsh habitat, while retaining existing non-tidal wetland habitat values (except Alternative 3) and enhancing endangered species habitat values. In this sense, all the alternatives are ecologically efficient, especially Alternative 1 and Revised Alternative 2 as they produce these results to a greater degree. Revised Alternative 2 is again the most efficient.

Table 4-13 Comparative Ecological Efficiency of the Study Alternatives

Alternative	*Average Annual Habitat Units*	*Total Acres of Wetland Created*	*Wetland Habitat Value Gain Per Acre*
1	426	1089	0.39
2, revised	526	1176	0.45
3	272	1284	0.21

The no-action alternative maintains existing habitats on the BMKV parcel, but fails to restore valuable habitats that have suffered severe historic losses and which provide endangered species habitat. As this alternative would create neither ecological losses nor ecological gains, it can not be considered to be ecologically efficient or inefficient. Nonetheless, it represents a lost opportunity for improving environmental quality.

Overall Efficiency

In terms of average costs, Alternative 3 is most cost-efficient at producing wetland habitat on the BMKV site, with Revised Alternative 2 being efficient for its level of habitat output. Revised Alternative 2 is most efficient ecologically. Alternative 1 and Revised Alternative 2 have similar cost-efficiencies for dredged material disposal. Therefore, for Revised Alternative 2, the combined efficiency in providing upland disposal of dredged material and wetland habitat is high.

4.5.3 Acceptability

Acceptability is the workability and viability of the alternative plans with respect to acceptance by state and local entities, as well as the public, and compatibility with existing laws, regulations, and public policies. The No Action Plan is not acceptable to any federal or state agency involved in the project. As revised, Alternative 2 is acceptable to the non-federal sponsor, local agencies, and the resources agencies, provided that concerns over such issues as drainage, flood control, and levee stability are adequately addressed. Table 4-14 shows the responsiveness of the alternatives to various local, regional, and federal plans. Revised Alternative 2 is the most responsive to these plans because it provides the maximum wetland habitat value and the most efficient beneficial reuse of dredged material.

Table 4-14 Responsiveness of the Expansion Alternatives to Local, Regional and Federal Plans

	Alternatives		
Plan/Agency	***1***	***2***	***3***
San Francisco Bay Plan / S.F. Bay Conservation and Development Commission	H	H	L
General Plan / City of Novato	M	H	M
Draft S.F. Estuary Ecosystem Goals Report / Interagency Project	M	H	M
S.F. Estuary Comprehensive Conservation and Management Plan / S.F. Estuary Project	M	H	M
Long-Term Management Strategy / Interagency Program	H	H	L
Ecosystem Restoration Program Plan / CALFED	M	H	M
Oakland Harbor Navigation Improvement / Corps of Engineers and Port of Oakland	H	H	L

L = low M = medium H = high

4.6 Tradeoff Analysis

4.6.1 Display of Relative Rankings

The three alternatives were assigned relative rankings indicating how well they would address the study objectives and selected evaluation criteria. A ranking of 1 indicates that the alternative best satisfies that objective or criterion. Economic efficiency ratings were determined using average rather than marginal economic costs. Ecological efficiency was not included due to important qualitative considerations. The rankings are displayed in Table 4-15. Note that in some cases alternatives were tied in their rankings.

4.6.2 Tradeoffs between Alternatives

Wetlands

As discussed in Section 4.5.2, all of the action alternatives are effective in restoring wetland habitat. Revised Alternative 2 is the most effective, as it restores a greater quantity of this habitat than Alternative 1, and achieves restoration more quickly than Alternative 3. Considering the diversity of habitat, Alternative 3 is again unsatisfactory as it does not allow for the creation of seasonal wetlands and limits the amount of upland habitat and high tide refugia that can be created. Revised Alternative 2 provides the greatest diversity of habitat. Because Revised Alternative 2 provides a greater quantity of habitat than Alternative 1, provides this habitat more quickly than Alternative 3 and provides a greater diversity than either Alternative 1 or 3, Alternative 2 best meets this study objective.

Table 4-15 Relative Rankings of the Study Alternatives by Study Objectives and Evaluation Criteria

Objective or criterion	**Alternatives**		
	1	***2, revised***	***3***
Wetland Restoration			
Endangered species	1	1	3
Creation of habitat value	2	1	3
Beneficial Reuse of Dredged Material			
Upland dredged material disposal capacity	2	1	3
Other considerations			
Economic efficiency- wetland	3	2	1
Economic efficiency- dredged material	1	1	N/A
Acceptability	2	1	3

Endangered Species Habitat
Although Alternative 3 would eventually provide a greater quantity of endangered species habitat, Alternative 1 and Revised Alternative 2 would provide substantial amounts of endangered species habitat more quickly than under Alternative 3. The two endangered species of particular concern here, the California clapper rail and the salt marsh harvest mouse, only occur around the San Francisco Estuary. These species have lost the vast majority of their habitat, and the clapper rail in particular is close to extinction. Provision of additional habitat for these species is considered to be very important by the resource agencies. Considerably accelerating the creation of this additional habitat would be a major benefit of Alternative 1 and Revised Alternative 2. Alternative 1 and Revised Alternative 2 would provide more endangered species habitat value and therefore best meet this study objective.

Beneficial Reuse of Dredged Material
Using dredged material to accelerate the creation of habitat is a more costly method of producing wetland habitat units than natural sedimentation. Alternative 1 and Revised Alternative 2, which would use dredged material, would cost far more than Alternative 3, which would use only natural sedimentation. However, Alternative 1 and Revised Alternative 2 would alleviate the public concern regarding the environmental impacts of disposing of dredged material in an aquatic environment. Although Alternative 1 provides slightly greater efficiency in dredged material placement, Revised Alternative 2 would beneficially utilize slightly more dredged material, and so best meets this study objective.

Replacement of Seasonal Wetlands Alternative 3 does not provide any in-kind replacement of seasonal wetlands, Alternative 1 provides limited in-kind replacement, and Revised Alternative 2 provides the highest level of in-kind replacement of the seasonal wetlands. Considering this factor, Revised Alternative 2 performs more favorably than Alternatives 1 or 3.

Summary
Revised Alternative 2 is selected as the preferred alternative because it provides the greatest diversity of habitat, allows for the beneficial reuse of the greatest quantity dredged material, provides critical endangered species habitat in the shortest amount of time, and replaces the

greatest amount of seasonal wetland. Given all these considerations, Revised Alternative 2 best addresses the study objectives of ecosystem restoration and beneficial reuse of dredged material. Revised Alternative 2 also best addresses the other evaluation criteria of completeness, effectiveness, efficiency, and acceptability, while minimizing ongoing management.

5.0 THE SELECTED PLAN

5.1 PLAN DESCRIPTION

If the HWRP is reauthorized to include BMKV, Revised Alternative 2 (the Selected Plan), in combination with the selected plan of the currently authorized HWRP, would restore wetlands on the HAAF, SLC and BMKV parcels using dredged material and natural sedimentation. Before dredged material is placed in the area, perimeter levees would be constructed. The bayward levee would be breached after dredged material placement. Although wetlands on all parcels would be restored, the HAAF parcel will be hydrologically separated from the SLC and BMKV parcels because of the need to continue operation and maintain access of the NSD outfall pipeline that will be re-constructed as part of the authorized HWRP.

5.1.1 Construction and Restoration Timing

Inclusion of the selected plan for BMKV expansion of the HWRP increases the estimated time to construct the combined areas to approximately 16 years including site preparation, placement of dredged material and breaching the outboard levees. The construction will be accomplished in phases that will provide flexibility for dredged material disposal. Over the long term, the phased construction and restoration will provide a reduction to In-Bay dredged material disposal practices while increasing wildlife habitat.

5.1.2 Site Preparation

Site preparation activities under the Selected Plan include: removing remaining buildings and structures; providing temporary drainage; relocating the NSD dechlorination plant; replacing the NSD outfall pipeline; installing and operating the hydraulic off-loader and piping to transport dredged materials to the HAAF, SLC and BMKV parcels; staged construction of perimeter levees, berms, and internal peninsulas; placement and consolidation of dredged material; lowering the bayward levee; breaching the bayward levee; and cutting channel through outboard marsh.

To provide temporary drainage for rainfall and process water resulting from dredged material placement from the HAAF, SLC and BMKV parcels, drainage weirs would be installed through the outboard levee. To maintain water quality, settling basins will be constructed upstream of these weirs. These weirs and/or pumps would be removed when the bayward levee is lowered.

As part of the expanded portion of the project, perimeter levees would separate the BMKV restoration site from the BMK residential community, Pacheco Pond and the HAAF. Construction of an additional 2,200 feet of levee is currently authorized as part of the original HWRP to provide continued protection and access to the NSD outfall. To achieve a long-term levee crest elevation of +8 feet NGVD, perimeter levees would be

constructed in two or more stages to an elevation of 10 feet initially, to accommodate an estimated 4 to 6 feet of long-term settlement.

Levee design would provide adequate stability to withstand potential earthquake-induced ground failure. End-of-construction conditions necessary to satisfy the stability factor of safety would be met by constructing levees with side slopes of approximately 3:1 (horizontal to vertical). Over time, as the levee settles and the underlying bay mud consolidates and gains strength, the stability factor of safety would increase to a level well in excess of the required stability criteria. Please refer to the technical appendices of this report for additional information of levee design considerations.

As with the existing HWRP, internal peninsulas would also be constructed within the BMKV portion of the expanded project area. The primary objective of the peninsulas is to reduce fetch and the potential for erosion of perimeter levees from wave action. The anticipated cross-sectional dimensions of the internal peninsulas, subject to final design changes, are shown in Appendix D. These peninsulas will be separated from the perimeter levee to reduce predator access and will be designed to subside into the marsh plane as the habitat matures.

5.1.3 Placement of Dredged Material

To allow the use of dredged material, a hydraulic off-loader would be placed in San Pablo Bay and piping would be installed to connect the off-loader to the HWRP and BMKV parcels. The off-loader would be powered by either electricity or diesel and would likely remain in the same approximate location throughout the additional years needed to construct the BMKV expansion to the project. Although the exact timing of delivery of dredged material to the off-loader is determined by the needs of the contributing dredging projects, the off-loader is intended to be operational and ready to pump ashore around the clock during the annual dredging season.

The off-loader would be properly marked and lighted, and the pipeline would be submerged and marked, consistent with U.S. Coast Guard regulations, to prevent navigational hazards to watercraft using the area at all times of the day and night. The U.S. Coast Guard would be notified to include an update on project activities in its Local Notice to Mariners.

Dredged material for the wetland restoration project (HWRP) could originate from many sources. One of the most likely sources is the Port of Oakland –50 ft Deepening Project. Other potential sources of material include Federal Operation and Maintenance projects such as Oakland Harbor, Pinole Shoals, Redwood City Harbor, Richmond Harbor and Southhampton Shoals, and non-Federal Operation and Maintenance projects such as Chevron, Larkspur Ferry, Ports of Oakland and Redwood City, San Francisco and Richmond Berths and TOSCO and UNICAL, and Bel Marin Keys Community Services District and Marin County Flood Control and Water Conservation District. Evaluating impacts associated with dredging and transporting material to the off-loader is assumed to be the responsibility of the sponsor of each dredging project. An EIR/EIS was recently

completed on the Oakland Harbor navigation improvement project (U.S. Army Corps of Engineers and Port of Oakland 1998a, 1998b, 1998c, and 1998d). That document addressed impacts associated with transporting dredged material to the HAAF parcel and concluded that transporting material on barges would not result in significant impacts on the environment. Since the off-loader location in San Pablo Bay is not likely to change when dredged material placement activities shift to the BMKV parcel, these conclusions hold for the expanded project as well.

The off-loading of dredged material would involve mixing the material with water to allow pumping. After the dredged material slurry is placed, the water would separate from the material and would eventually be discharged to back to San Pablo Bay. San Francisco Bay Regional Water Quality Control Board quality standards will be specified in the wastewater discharge permits issued by the RWQCB. Certain options have been proposed that would ensure that the process water does not violate water quality standards when discharged to the bay. The most viable option is to hold the water in settling ponds within the restoration site for subsequent discharge.

5.1.4 Lowering and Breaching the Bayward Levees

After individual tidal wetland cells of the expanded project are filled to grade with dredged material and allowed time to consolidate, the outboard levees will be breached in the location of the main tidal channel connection to San Pablo Bay. In conjunction with breaching, large sections of the outboard levees would be lowered to an elevation similar to the elevation of the marsh plain adjacent to the levee. However, some portions of the levees would remain at higher elevations to provide high tide refuge. In addition to levee breaching, a pilot channel will be cut through the outboard marsh mudflat to aid in the establishment of the tidal channel serving each drainage basin. The excavated material from the pilot channel cuts would be placed within the restoration area.

Track-mounted excavators would likely be used to excavate the levee breaches and could be used to excavate the pilot channel. Alternatively, a suction dredge could be used to excavate the pilot channels. Material excavated by the dredge would be pumped directly to the site. This method could limit the amount of coastal salt marsh disturbed during the dredging process. Breaches will be timed to ensure that marsh establishment is not delayed, provided that the Government determines that each of the following is true in light of the state of completion of the construction features of the project: (1) breach of the bayward levee does not cause undue risk of property damage to parcels of real property adjoining the project site, (2) breach of the bayward levee does not cause undue risk of environmental harm to the project site or the surrounding environment, and (3) breach of the bayward levee reflects sound engineering practice and judgment.

5.1.5 Evolution of Site

The appearance of the site will evolve over time. Initially, the tidal section of the site will consist of subtidal and intertidal mudflat habitats. The incoming San Pablo Bay waters will introduce invertebrates that will rapidly colonize the intertidal mudflats,

providing a food source for shorebirds and waterfowl. Bay waters will also introduce a variety of fish to the site such as chinook salmon, striped bass, green sturgeon, steelhead trout, staghorn sculpin, inland silversides, and Pacific herring. As sediment builds, cordgrass will begin to colonize the site, followed by species such as pickleweed, jaumea, alkali heath, gumplant, and salt grass. The growth of vegetation will be accompanied by the development of the slough channel network. Channels will be broad and undefined at the time of the breach, developing more complexity as the marsh plain elevation increases. Tidal ponds, which were a feature of the historic landscape, are expected to form in the mature marsh.

Tidal pannes are the transitional habitats between areas that receive daily tidal action and non-tidal habitats; seasonal wetland, grassland, and upland. Seasonal wetlands will shallowly pond precipitation, and will have a mixture of areas that have minimal, low-growing vegetation and a drainage channel supporting taller, emergent vegetation such as cattail, bulrush, and some willows along the edge. Many of the bird species present in the tidal wetlands will also use the seasonal wetlands. Seasonal wetland invertebrate communities typically include zooplankton, aquatic beetles, bugs, and flies. Fish are not typically found in seasonal wetlands due to their seasonality and shallow depths. As the annual and perennial grassland and upland habitats mature, shrubs will voluntarily colonize the area.

5.2 Summary of Benefits

Revised Alternative 2 has been chosen as the Selected Plan because it best meets the study purposes and the study goal. Revised Alternative 2 creates the most wetland habitat value and provides the greatest benefits to endangered species. When combined with the authorized HWRP, this alternative provides disposal capacity for approximately 24.4 million cubic yards of dredged material (approximately 13.8 mcy in addition to the currently authorized HWRP capacity of 10.6 mcy). It minimizes the impacts of aquatic disposal of dredged material in the bay and ocean. The habitat benefits obtained from using dredged material to accelerate tidal marsh restoration are relatively expensive when compared to those obtained when restoring tidal marsh using only natural sedimentation. However, using dredged material will substantially decrease the time necessary for the restored wetlands to become fully functional. This will accelerate the habitat benefits due to earlier creation of habitat for endangered species of high public and regulatory concern. These accelerated habitat benefits can be considered a free benefit of using an economically efficient method of upland disposal of dredged material, and are additionally supplemented by the unquantified benefits of avoiding aquatic disposal of this material. For these reasons, Revised Alternative 2 best implements a number of federal, state, regional, and local plans, including the Long Term Management Strategy for Dredging and Dredged Material Management in San Francisco Bay (LTMS).

5.3 ENVIRONMENTAL REQUIREMENTS AND COMMITMENTS

5.3.1 Water Resources Council Environmental Requirements

The table on the following page, Table 5-1, shows the Selected Plan compliance with the Water Resources Council environmental requirements. It references the statute concerned, the state of compliance and a description of those areas still being completed.

5.3.2 NEPA Compliance

The project has been assessed through the NEPA and CEQA processes. The environmental impacts of the Selected plan and alternatives are assessed in the Supplemental Environmental Impact Statement/Report (SEIS/R).

5.3.3 Clean Water Act

A preliminary 404(b)(1) report has been prepared to assess impacts to wetlands and waters of the US and is included as Appendix B of the attached SEIS/R. A Section 402 discharge permit will be obtained from the San Francisco Bay RWQCB.

5.3.4 Fish & Wildlife Coordination Act

The FWS, under contract to the Corps, is in the process of reassessing the draft HWRP Coordination Act Report (DCAR) to include BMKV. The updated DCAR was delivered in February 2003 and is currently in review.

5.3.5 Endangered Species Act

The Endangered Species Act (ESA) requires federal agencies whose action may affect endangered species to go through a specified consultation process. The Corps, in August 1998, requested from the FWS a list of proposed, threatened, and endangered species that may be present at the project site; the FWS provided the species list. Then the Corps prepared a Biological Assessment (BA) to analyze the effect of the project on listed species which may be present, in this case, California clapper rail and salt marsh harvest mouse. The BA (Jones & Stokes, August 1998) was submitted to FWS on August 24, 1998. The next step is for FWS to review the BA and then provide a Biological Opinion (BO). FWS has requested a programmatic consultation covering all actions at the authorized HWRP site and the BMKV site proposed for reauthorization. A Biological Assessment (BA) regarding the authorized HWRP is currently under review by FWS; an additional BA is being prepared for the BMKV parcel.

Table 5-1 Selected Plan Compliance with Water Resources Council Environmental Requirements

Statute	Compliance	Description of Compliance
Anadromous Fish Conservation Act, 16 USC 757 *et seq.*	N/A	
Archeological and Historic Preservation Act of 1980. 16 USC 469, *et seq.*	Full	The BMKV parcel has been fully evaluated.
National Historic Preservation Act of 1966 16 USC 470, *et seq.*	Full	The BMKV parcel has been fully evaluated.
Clean Air Act of 1972 42 USC 7401, *et seq.*	Full	A BAAQMD permit, mitigation and offsets may be required if diesel power is chosen for the offloading and/or booster pumps.
Clean Water Act of 1972 33 USC 1251, *et seq.*	Partial	A preliminary 404(b)(1) report has been prepared. A Section 402 discharge permit will be obtained from the San Francisco Bay RWQCB.
Coastal Zone Management Act of 1972 16 USC 1451, *et seq.*	Partial	Once design is complete, a Consistency Determination will be prepared. BCDC has endorsed the project concept.
Endangered Species Act of 1973 16 USC 1531, *et seq.*	Partial	Consultation has begun. A BA is being prepared for the BMKV parcel.
Estuary Protection Act of 1963 16 USC 1221, *et seq.*	Full	
Farmland Protection Policy Act of 1981, 7 USC 4201, *et seq.*	Partial	Preliminary ranking under LESA completed. Consultation with NRCS to be completed.
Federal Water Project Recreation Act of 1965. 16 USC 460, *et seq.*	N/A	
Fish & Wildlife Coordination Act of 1958 16 USC 661, *et seq.*	Partial	The DCAR is scheduled to be completed by December 2002. The FCAR will be finished after design is complete and ESA consultation concluded.
Land and Water Conservation Fund Act of 1965. 16 USC 460, *et seq.*	Full	
Magnuson-Stevens Fishery Conservation and Management Act 16 USC 1801 *et seq.*	Partial	Essential Fish Habitat assessment to be prepared during design phase.
Marine Protection, Research, and Sanctuaries Act 16 USC 1431 *et seq.*	N/A	
Migratory Bird Treaty Act of 1918, Title 16 US Code Sec.703-712	Full	
National Environmental Policy Act of 1969 42 USC 4321, *et seq.*	Full	The public review period for the Draft SEIS/R was July 19th through September 13th. The Final SEIS/R is being circulated with this report.
Rivers & Harbors Act of 1899 33 USC 403, *et seq.*	N/A	
Watershed Protection & Flood Control Act of 1954. 16 USC 1001, *et seq.*	Full	
Wild & Scenic Rivers Act of 1968. 16 USC 1271, *et seq.*	N/A	

5.3.6 Coastal Zone Management Act

Once design is complete, a Consistency Determination will be prepared. The responsible Coastal Zone Management Act (CZMA) agency, BCDC, has endorsed the project concept and has co-managed the project with the SCC.

5.3.7 Cultural Resources Compliance

Full compliance with the National Historic Preservation Act of 1966 and the Archaeological and Historic Preservation Act of 1980 has been achieved for the BMKV parcel. The requirements of these acts include site surveys and coordination with the State Historic Preservation Officer (SHPO). A detailed description of the actions taken to ensure cultural resources compliance is provided in Chapter 4 of the SEIS/R associated with this GRR. The boundaries of the Bay Trail alignment proposed in Alternative 1 are outside the boundary of the BMKV parcel. Additional work is in progress to evaluate the cultural resources impact in this area.

5.3.8 Resources of Principal National Significance

Following is a table summarizing the effects of the Selected plan on Resources of Principal National Significance.

Table 5-2 Effects on Resources of Principal National Significance

Resource	Source of National Recognition	Description of Effects
Air quality	Clean Air Act	None
Sensitive coastal zone areas	Coastal Zone Management Act	Creates new tidal areas
Endangered & threatened species	Endangered Species Act	Increases habitat
Fish & wildlife	Fish & Wildlife Coordination Act	Increases habitat for wetland species
Floodplains	EO 11988 Floodplain Management	F-2 Zoning issues under examination
Historic and archeological properties	National Historic Preservation Act	None
Prime & unique farmland	CEQ Memorandum August 1, 1980	None in project area
Water quality	Clean Water Act	Temporary increase in turbidity during construction
Wetlands	Clean Water Act	Creates large new wetland area
Wild & Scenic rivers	Wild & Scenic Rivers Act	None in project area

5.3.9 Environmental Commitments

The following environmental commitments are in the Selected plan:

a. The Corps has prepared a Clean Water Act Section 404(b)1 evaluation. In addition, State water quality certification will be obtained after Plans and

Specifications (P&S) are completed and before the construction contract is awarded.

b. Dredged material will meet LTMS wetland cover sediment standards.
c. Threatened and endangered species will be protected during construction, under ESA requirements. The biological opinion will be provided before P&S are completed.
d. The NSD outfall pipeline and NHP drainage facilities will be protected from adverse impacts due to construction.

5.4 Real Estate Requirements

The real estate requirements for the Bel Marin Keys Unit V (BMKV) Expansion of the Hamilton Wetland Restoration Project (HWRP) consist of the lands and estates shown below for the HWRP and the lands and estates for the BMKV Expansion as follows:

HWRP

Feature	Estate	Owner	Acreage
Wetland Site	Fee	Army	644.19 acres
Wetland Site	Fee	SLC	318.62 acres
Wetland Site	Fee	Navy	18.37 acres
Levee	Flood Protection Levee Easement	City of Novato	5.59 acres
Pipeline	Pipeline Easement	SLC	0.76 acre

BMKV

Feature	Estate	Owner	Acreage
Wetland Site	Fee	NFS	1610 acres
*Access Area	Fee	City of Novato	2 acres

*The Access Area will accommodate a display board, parking area, and restrooms. The two-acre area required for this purpose is located adjacent to the west side of the HWRP (panhandle area).

The total real estate values for the HWRP were estimated for HWRP Feasibility Report prepared in 1999. They are $80,743. The total real estate values for the BMKV Project are $19,109,201. The total real estate cost, to include administrative costs is $19,438,225.

The sponsor shall provide all lands, easements, rights of way, relocations and disposal sites (LERRDs) for the construction, operation, and maintenance of this project. This is in accordance with the provisions of the terms of Water Resources Development Act of 1986 (WRDA '86) and the Project Cooperation Agreement (PCA). (The real estate requirements are described in more detail in the Real Estate Plan, Appendix F of this GRR).

There are no Public Law 91-646 Relocations for the recommended plan. The utilities affected by this project are five PG&E high voltage power line towers on the Vaca-Ignacio Line and the relocation/replacement of the Novato Sanitary District (NSD) Outfall Pipeline. The five PG&E towers are construction costs and not utility relocations. The replacement of the outfall pipeline to its new location (existing one will be abandoned in place) is a Utility Relocation. An Attorney's Opinion of Compensability

has been prepared which determined that this work is compensable. This utility relocation will be cost shared under LERRDs.

5.5 Engineering Requirements

The engineering requirements of the Selected BMKV expansion Plan are addressed in the technical appendices of this report. The engineering appendices contains hydrologic and hydraulic studies, surveying and mapping provisions, geotechnical information, civil engineering information and project design considerations. Comparative studies, detailed investigation and design are expressed in sufficient detail and determine the recommended plan and its baseline estimate.

The NMWD is considering a plan to extend a water line from Ammo Hill to Bel Marin Keys Boulevard (see Figure 1-2 in SEIR/S). It is conceivable that the water line could be built during construction of the proposed BMKV expansion. The likely location of the line would be along the existing or new levees constructed along the western side of the BMKV parcel. The NMWD would need to obtain an easement from the Conservancy. Simultaneous construction of the water line and the restoration project is feasible within the designs proposed. Neither construction of the water line nor granting the easement is included as part of the proposed BMKV expansion. However, the design alternatives do not preclude granting the easement or constructing the water line. The Corps and Conservancy will work with the NMWD to examine how the water line planning can be incorporated into the final design of the BMKV expansion. If the proposed water line extension is later determined to result in any additional impacts beyond those analyzed the SEIS/R for earthworks construction and habitat restoration, a supplemental environmental compliance document may be necessary.

5.6 Operation, Maintenance, Repair, Replacement, and Rehabilitation Requirements

A conceptual plan for Monitoring and Adaptive Management the project after construction has been produced and is included in Appendix I - Conceptual Monitoring and Adaptive Management Plan. The conceptual plan will be greatly expanded and quantified in the detailed design phase of the study.

The plan covers the period after the completion of construction. At the beginning of restoration post-construction phase, dredged material will have been placed and the bayward levee breached. Maintenance and monitoring during construction will be described in the plans and specifications for construction. Only dredged material qualified as suitable for wetland placement will be deposited on site.

After construction is complete on the entire project or a functional portion of the project, it will be monitored for 13 years to insure adequate performance. The Corps will participate in this monitoring and any adaptive management measures required during this period. After construction is complete on the entire project or a functional portion of the project, the non-Federal sponsor shall assume responsibility for operation,

maintenance, repair, replacement, and rehabilitation of the project or applicable functional portion. This responsibility shall extend for as long as the project remains authorized, unless this responsibility is properly transferred to a third party in accordance with the items of local cooperation and the terms of the Project Cooperation Agreement. Operation, maintenance, repair, replacement, and rehabilitation will include inspections and surveys of the levees and water management structures and other project features.

Monitoring of biological, hydrological, topographic, bathymetric, and chemical conditions will track the evolution of the site after breaching of the bayward levee. Periodic comparisons of measured conditions with expected conditions will determine whether the development of the site is progressing as planned.

The Corps of Engineers will participate in the monitoring an adaptive management program for 13 years after the end of construction. This period was chosen because it would be approximately the halfway point of the post-construction restoration process.

Normally, Corps monitoring of a non-reservoir project ends upon completion of construction. All further operations and maintenance, including monitoring of the project's structural integrity, are then the responsibility of the local sponsor. An exception may be made for monitoring of mitigation plantings, which may extend for five years beyond the end of construction.

This project will be constructed partially through natural sedimentation over a period of approximately 20 years, facilitated by breaching the outboard levee. This sedimentation process, and associated development of marsh vegetation and appropriate micro-topography, including tidal channels, is essential to completion of the project and ultimate success of the restored marsh as endangered species habitat. Proof that natural processes are indeed guiding maturation of the marsh as planned can only be established after substantial evidence is obtained that sedimentation, channel formation and vegetation are progressing properly. A typical Corps project five-year monitoring period would not be adequate to determine this outcome, as little marsh will have developed by that time. It is expected that a 13-year monitoring and adaptive management period should be adequate to establish the likely success of the project. Seventy-five percent of the new tidal marsh habitat is expected to be established by year 13. The cost-shared period of implementation of monitoring and adaptive management shall commence on the date that notice is provided to the non-Federal sponsor that the project or a functional portion of the project is complete. This 13-year period will run concurrently with the non-Federal sponsor's responsibilities to operate, maintain, repair, replace, and rehabilitate the project or functional portion thereof. Continued surveillance after the 13-year monitoring and adaptive management period will be the responsibility of the non-Federal sponsor as a component of its obligation to operate, maintain, repair, replace, and rehabilitate the project. The requirements for OMRR&R by the non-Federal Sponsor during and after the 13-year monitoring period will be specifically defined in the OMRR&R plan for the Project, which will be developed during PED.

5.7 Summary of Costs

Table 5-3 presents a summary of costs for the Selected plan.

Table 5-3 Summary of Costs

Summary of Costs for the Selected Plan (Revised Alternative 2) (2002 Price Levels)	
Lands and Damages	$19,438,225
Relocations	$324,765
Levees and Floodwalls	$44,082,158
Dredged Material Placement	$96,316,103
Recreation Features	$181,483
Planning, Engineering & Design (PE&D)	$11,260,000
E&D/Construction Management (S&A)	$11,118,920
Total Implementation Cost (BMKV only)	$182,721,654
Interest During Construction	$28,718,764
Total Investment Cost	$211,440,418
Average Annual Cost (@5.875 %)	$ 13,181,196
Other OMRR&R Costs	$ 525,000
Total Annual Cost	$ 13,706,196

5.7.1. Basis of Cost

The Corps of Engineers' Micro Computer Aided Cost Estimating System (MCACES) was used to develop the construction cost of the BMKV expansion project. The estimated costs presented in this report are based on October 2002 price levels, a 50-year period of analysis and the present Federal Discount Rate of 5.875 percent. This estimate is based on the Administrative Draft - Supplemental Environmental Impact Report/Environmental Impact Statement (SEIR/EIS) to the Hamilton Wetland Restoration Plan EIS/EIR for the Bel Marin Keys Unit V Wetland Restoration Project and the Hamilton Wetland Woodward-Clyde concept plan, reference "Hamilton Wetlands Conceptual Restoration Plan" and "Technical Appendices", prepared by Woodward-Clyde for the State Coastal Conservancy, the City of Novato, April 24, 1998 and other most current estimated and investigative information from the Civil Design (ED) and Programs and Project Management Division (PPMD) of the San Francisco District, USACE.

5.7.1.1 Project Phasing

PED Phase: The Pre-construction, Engineering, and Design Phase will take approximately 18 to 24 months to complete.

Phase 1: The majority of work for this project is the levee construction which will take approximately two years to construct. This involves site preparation for the placement of dredged material. It also includes hydroseeding levees. The HWRP start date is scheduled to begin FY 2003 or early FY 2004. This phase could be

accelerated through authorization and/or a congressional add for reauthorization of the HWRP Bel Marin Keys expansion project.

Phase 2: The placement and grading of dredged material to create wetland would take approximately four to eight years.

Phase 3: Lowering levee, breaching levee, construction of the outboard marsh channels, and weir structures removal is expected to take a maximum of one year to complete. Monitoring, maintenance, and adaptive management would take place over a 13 year period.

5.7.1.2 Pricing

Estimated costs are based on an October 2002 price level. Plant and equipment costs are from EP 1110-1-8 "Construction Equipment Ownership and Operating Expense Schedule, Region 7" 1999 database, "Unit Price Book" (UPB) 2001 database, and "National Labor Rates" 2000 database supplied with the MCACES program. The project labor rates have been adjusted to current State of California Wage Rate Determination sheets. Material costs are from the MCACES databases, publications and previous studies. Cost estimates from the Woodward-Clyde concept plan are also used in the MCACES estimate.

5.7.1.3 Contract Work

It was assumed that the prime contractor will perform all features of work, 5 days a week, 8 hours per day. No overtime work is anticipated at this time.

5.7.1.4 Levee Construction

New Levees with Bench:	13,300 linear feet for Alternative 1
	21,000 linear feet for Revised Alternative 2
	11,400 linear feet for Alternative 3
Improved Levees/Berms:	37,500 linear feet for Alternative 1
	36,400 linear feet for Revised Alternative 2
	8,800 linear feet for Alternative 3
Phase Containment Levees:	30,400 linear feet for Alternative 1
	19,200 linear feet for Revised Alternative 2
	6,500 linear feet for Alternative 3
Internal Peninsulas/Berms:	15,800 linear feet for Alternative 1
	18,200 linear feet for Revised Alternative 2
	26,500 linear feet for Alternative 3
Pilot Channel Excavation:	2,100 linear feet for Alternative 1
	1,800 linear feet for Revised Alternative 2
	1,200 linear feet for Alternative 3

Material for levee construction would be obtained by excavating borrow material at a depth of 2 feet from designated areas within the BMKV site. Material would be placed, compacted and shaped to form levees at the designated footprints. Cross-sections used in this estimate were estimated for the Hamilton Wetland Restoration Feasibility Report or more recent investigations for Revised Alternative 2.

The cost estimate reflects the initial construction of the levees, and the subsequent raising of said levees, in three phases/stages to address concerns from the surrounding communities. Information for the construction of the levees in stages were provided by Civil Design and Geotechnical, San Francisco District and are as follows: (1) construction of the initial levees, (2) stage 1 construction approximately 4 years after completion of initial construction, and (3) stage 2 construction approximately 17 years after completion of stage 2 construction. A bulking factor of 1.4 has been used where applicable.

During the Hamilton Wetland Restoration Project, levees along the perimeter of the SLC parcel and along the NSD outfall pipeline will be constructed to provide a separation between the Hamilton and BMKV parcels. If the BMKV expansion is authorized, and the wetlands are established, these levees will be excavated to the desired wetland restoration topographic elevation. The excavated material would be used either as borrow material to improve or raise these levees or as coverage material where necessary.

5.7.1.5 Breaching of the levees
Breaching and lowering of the existing bayward levee and breaching of the existing levee along the Novato Creek are the proposed plan for Revised Alternative 2. The levee constructed between the Hamilton and SLC/BMKV parcels would be excavated down to desired elevation if the BMKV expansion is authorized.

5.7.1.6 Weir and Culvert structures
Existing weirs inadequate to provide the desired flow of water will be removed and replaced with more adequate weirs and culverts. Construction of new culverts with flapgates will provide for the transfer of water from existing water sources into the newly created wetland, and from the newly created upland transition area to the newly tidal marsh area.

5.7.1.7 Building Demolition
The building demolition would consist of demolition, removal and disposal of buildings composed primarily of wood and sheet metal materials. Buildings range from 1,000 square feet to 10,000 square feet. Site-specific information of the existing buildings were provided by Civil Design Section and Corps consultants. Costs for lead paint removal is included in the estimate.

5.7.1.8 Mobilization and Demobilization
Assume all land based plant and equipment is available locally and mobilization would take 16 hours and demobilization would take 16 hours.

5.7.1.9 Monitoring
Monitoring consists of initial and final fill elevations for dredged material placement using resistivity staffs and remote monitoring equipment similar to Sonoma Baylands project. The cost is from the HWRP Feasibility Report cost estimate, and the Woodward-Clyde concept report.

5.7.1.10 Finish Grading
Finish grading of the dredged material consists of mixing the top 2 feet of dredged material placement to prevent complete desiccation and cracking of the top layer. It is assumed that the dredging contractors will construct the final 2 ft. finish layer with 1 ft. of sand as the first layer and the fine-grained material for the final 1 ft. layer.

5.7.1.11 Long Term Monitoring Costs
Long-term monitoring of the dredged material placed will be conducted for the authorized period of 13 years. Costs consists of monitor and maintenance of the levees, water control structures, tidal channel depth, aerial photos, transects monitoring, biological monitoring, water quality, and sedimentation surveys for a period of 13 years. These costs were developed by the Environmental Branch and Specifications and Cost Engineering Section, San Francisco District.

5.7.1.12 PG&E Towers
There are existing PG&E towers within the newly created marsh areas. This estimate includes the cost for concrete encasement of the tower legs at the base. The costs were referenced from Sonoma Baylands Wetlands Restoration Project completed in 1994.

5.7.1.13 Pacheco Pond Expansion
The estimate includes the expansion of the existing Pacheco Pond with some clearing and grubbing, tree removal, and breaching of the existing Pacheco Pond levee in several locations, thereby unifying the existing and new portions of the pond.

5.7.1.14 NSD Outfall Pipeline Modifications
The Revised Alternative 2 requires the modification of the existing outfall pipeline through the construction of a new section of pipeline around the east side of the newly expanded Pacheco pond. Costs were estimated based upon the existing HWRP cost for the pipeline per foot of line.

5.7.1.15 Bay Trail and Access Area
Costs include the construction of a new portion of the Bay Trail along the perimeter of the new wetland, and constructed on the new perimeter levee. The cost for a display board, restrooms, and a parking lot is based on relatively simple site grading for a new concrete slab on aggregate base that will accommodate approximately 20 spaces for cars.

5.7.1.16 Adaptive Management
The cost for adaptive management monitoring for the development of the wetland is estimated at 2% of the cost for the total project cost, based upon historical data from Corps projects.

5.7.1.17 Hydroseed of Levees
Hydroseeding was estimated based on the unit costs in the HWRP Feasibility Report.

5.7.1.18 Real Estate Costs
Real Estate costs were developed by Susan Miller, CESPN-PM and Mary Leotaud in Real Estate Division, CESPK.

5.7.1.19 Planning, Engineering and Design (PED, Construction Management (S&A) and Engineering and Design (E&D)
PED, S&A and E&D costs were provided by CESPN-PM San Francisco District, with consultation with the various engineering and construction services disciplines.

5.7.1.20 MCACES Assumptions
7.5% home office overhead, 8% profit, 1% bond; contingencies ranging from 10%-20%, depending on the construction task item. Contractor field cost items for the site construction are detailed in code 11 of the MCACES. Escalation of the various cost categories, i.e. Levees and Floodwalls, Navigation, Ports and Harbors, and Buildings, Grounds, and Utilities have been adjusted/escalated to reflect an estimated October 2002 price level. Reference escalation factors from the Civil Works Construction Cost Index System, 20 September 2002.

5.7.2 Interest During Construction

The Corps has accounted for the opportunity cost of capital used during the construction phase of project implementation. The calculation of Interest During Construction (IDC) is used to determine the total investment costs of a project. The IDC costs are added to the actual project costs to account for the total project cost. Project costs include: construction, lands, easements, rights-of-way; relocations and damages, utility relocations; engineering and design, supervision and administration; and contingencies. The IDC was calculated using the present Federal Discount Rate of 5.875 percent (FY02), and was applied to the first five years required to complete construction of the BMKV component of the total combined HWRP/BMKV project. Benefits will have accrued upon completion of the HWRP portion of the project and the first two cells of the BMKV addition, making IDC unnecessary for the final three years of the 16-year project construction period.

5.7.3 Cost Apportionment and Allocation

Costs associated with the alternatives are allocated to environmental restoration and recreation. For ecosystem restoration projects, the Federal share is 65%, while the non-Federal share is 35%. If beneficial reuse of dredged material is achieved, as in

Alternative 1 and Revised Alternative 2, the Federal share increases to 75%, while the non-Federal share decreases to 25%. In accordance with the US Army Corps Policy Guidance Letter 59, the cost of justified and approved recreation features will be cost shared at 50% Federal and 50% non-Federal, provided the Federal cost is not increased by more than 10%. The sponsor is responsible for providing all Lands, Easements, Rights of Way, Relocations and Disposal Sites (LERRDS), 50% of the costs associated with recreation features, and any cash contributions that may be required to bring the local share up to 25% of the total project cost associated with restoration features. The Federal and non-Federal share of project costs and the breakdown by project phase is presented in Chapter 6.

The major recreation features of the Selected plan include a detached restroom, display boards/kiosks, a parking lot (20 spaces), and the Bay Trail. The estimated cost of these features is $181,483. Inclusion of these recreation features is consistent with Corps policy regarding recreation development at ecosystem restoration projects; therefore the detached restroom, the display board/kiosk, the parking lot and the trail will be cost-shared at a rate of 50% Federal, 50% non-Federal.

The implementation cost of the Bel Marin Keys expansion portion of the HWRP is estimated to be $182,700,000. This cost would be funded as follows: non-Federal sponsor: $33,400,000 ($33,309,260 restoration and $90,740 recreation). Federal and non-Federal navigation projects: $49,100,000, and the Federal Construction General program: $100,200,000 ($100,109,260 restoration and $90,740 recreation).

5.8 Risk and Uncertainty

5.8.1 Uncertainty in Projections

Rate of Sedimentation

The timeframe for the evolution of wetland habitats on the site depends on the rate of natural sedimentation after breaching and re-introduction of tidal action. The actual rate of sedimentation realized is uncertain for several reasons. First, the volume of suspended sediments in San Pablo Bay waters exhibits large spatial and temporal variability. A long-term integrated data set of sediment rates is not available for this location. Project design relied on observed sedimentation rates from other shoreline locations and episodic sampling of suspended sediment loads in San Pablo Bay. Therefore, the actual concentration of suspended sediments in the tidal prism entering the expanded HWRP will not be known with certainty prior to breaching the site.

Secondly, the pattern of *net* sediment deposition on the site will depend on the interaction of sediment deposition and resuspension that depends, in turn, on tidal currents, wind and wave action, site design and the pattern of colonization by vegetation. These dynamics would be very difficult to model accurately for such a large site, even if the volume of sediments entering the site were known with certainty. Therefore, conservative estimates were used for deposition in the site using hydrodynamic modeling and derived sedimentation curves. A basic assumption was made that sediment deposition rates would

be higher at the front of the site near the sediment-rich tidal inlets, and lower in the distal areas of the restored tidal marsh.

Sources of Material
There is a wide range of potential dredging projects that could be used to construct site features the expanded HWRP. As part of the PED phase of the existing HWRP project, potential contributing dredging projects and anticipated supply schedules were developed. Based on this analysis, there is an adequate volume of dredged material that can feasibly be used to construct Hamilton site features. Please refer to Appendix D for a schedule of material to be delivered to the HWRP/BMKV project by each participating navigation project.

1) **New Work**. New work projects are desirable because they can provide large volumes of material rapidly and have better economies of scale and funding. The new work projects proposed in the region were evaluated for their feasibility and costs. Deepening projects at the Port of Oakland, Pinole Shoal, and Redwood City were Selected because they have a strong feasibility of implementation during the construction of HWRP and because they appear to be cost-effective for use at HWRP. The Port of Oakland –50 Foot Project is committed to provide 2.5 mcy to the HWRP.

2) **Maintenance Dredging**. Although maintenance dredging volumes are lower per episode than new work projects, they are dredged on a more predictable basis than deepening projects. The feasibility analysis used the larger Corps and private maintenance projects in Central Bay and San Pablo Bays. This analysis showed there is an adequate volume of material to construct the site. However, even if some of these projects are not subsequently available there are other maintenance projects that could be used instead. The plan proposes that all feasible Bay dredging projects with suitable material during the construction period will be used for Hamilton construction.

5.8.2 Monitoring Evaluation

The lengthy period of time required for the marsh plain to be developed necessitates a long term monitoring program. A typical five-year monitoring period is unlikely to be sufficient in measuring the ultimate success of the restoration project. Therefore, as previously indicated a 13-year monitoring and adaptive management program will be implemented on the expanded project. To reduce monitoring costs, periodic evaluations could be conducted to assess ongoing monitoring needs. Monitoring efforts could be reduced or eliminated as success criteria are met. In addition, more efficient methods of monitoring could be incorporated as familiarity with the site develops. Monitoring and evaluation would be developed further in PED as design elements are more clearly defined.

5.9 PROJECT IMPLEMENTATION

This section is not intended to imply a Government commitment to construction of the project prior to reauthorization and appropriation of funds by the Congress.

5.9.1 Construction Funding

The schedule for implementation of project expansion assumes reauthorization of the project in WRDA 2002. After the project is reauthorized, the expanded project would be eligible for construction funding in FY 2003. The project would be considered for inclusion in the President's budget based on national priorities, magnitude of the Federal commitment, economic and environmental feasibility level of local support, willingness of the non-Federal sponsor to fund its share of the project cost and budgetary constraints that may exist at the time of funding. If reauthorized and Congress appropriates Federal construction funds, the Corps and the non-Federal sponsor would modify the existing project cooperation agreement (PCA). This modified PCA would define the Federal and non-Federal responsibilities for implementing, operating, and maintaining the project, and is scheduled for execution in FY 2003.

5.9.2 Construction Sequencing

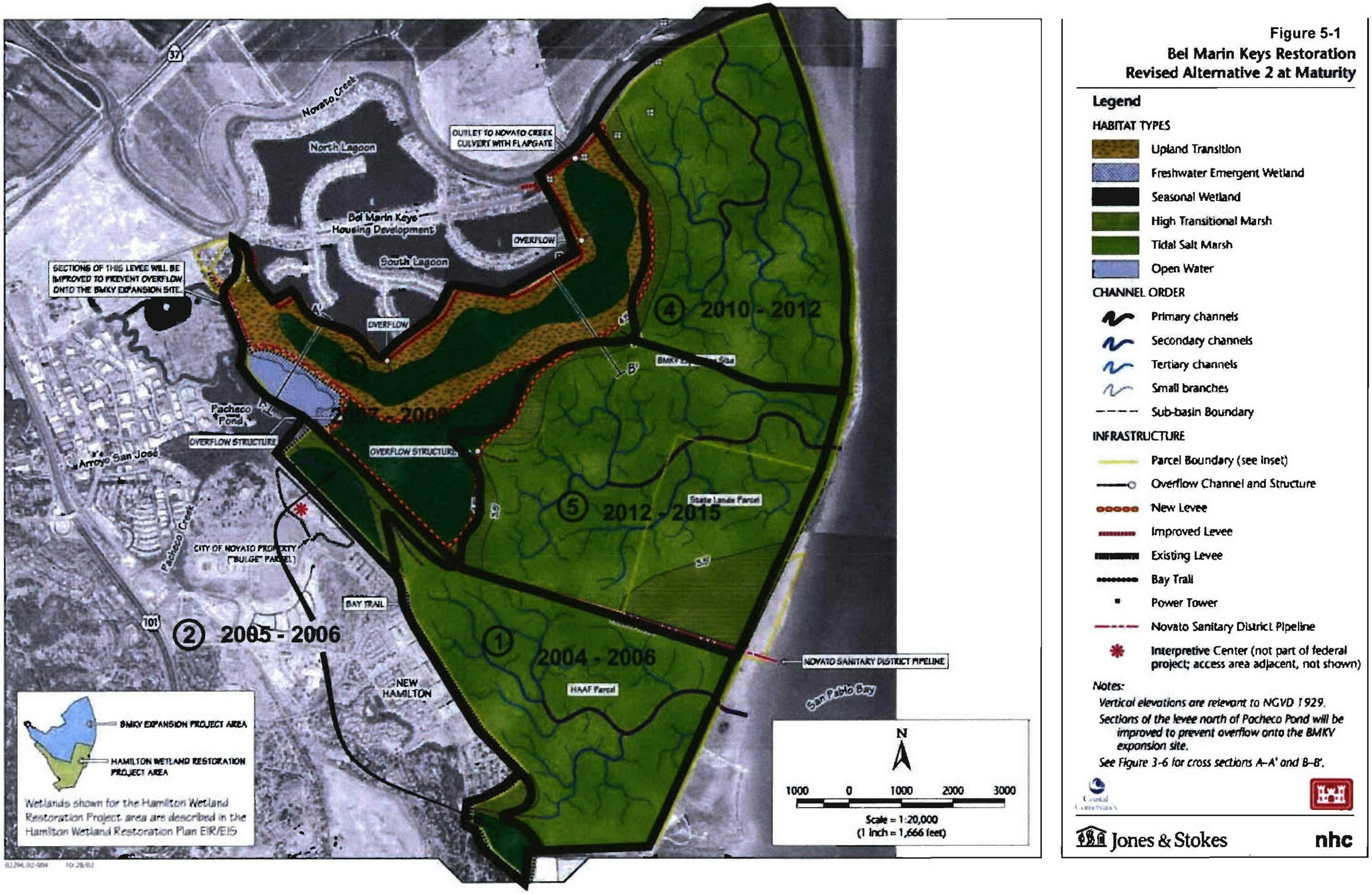
The preferable construction sequencing for the combined HWRP/BMKV project would be to start and complete construction of the wetland and upland habitat areas on the Hamilton Army Airfield and then begin construction on the combined BMKV and State Land Commission parcel areas. The two main reasons this sequence is preferable are that the Novato Sanitary District outfall pipeline access berm will physically and hydraulically divide these project areas and the sandy dredged material from the Port of Oakland –50 Foot Deepening Project, due to arrive in 2005-2006, is the preferable material for constructing the deep fills required in the seasonal wetland areas of the Hamilton Army Airfield.

However, this preferable construction sequence for the combined project may not be viable if there are delays in the BRAC action on the Hamilton Army Airfield and FUDS action on the State Land Commission parcel. Therefore, four alternative construction sequences were developed to demonstrate that the combined project could be constructed effectively with or without completion of the BRAC or FUDS. The BRAC action affects only the Hamilton Army Airfield parcel and the FUDS action affects only the State Land Commission parcel.

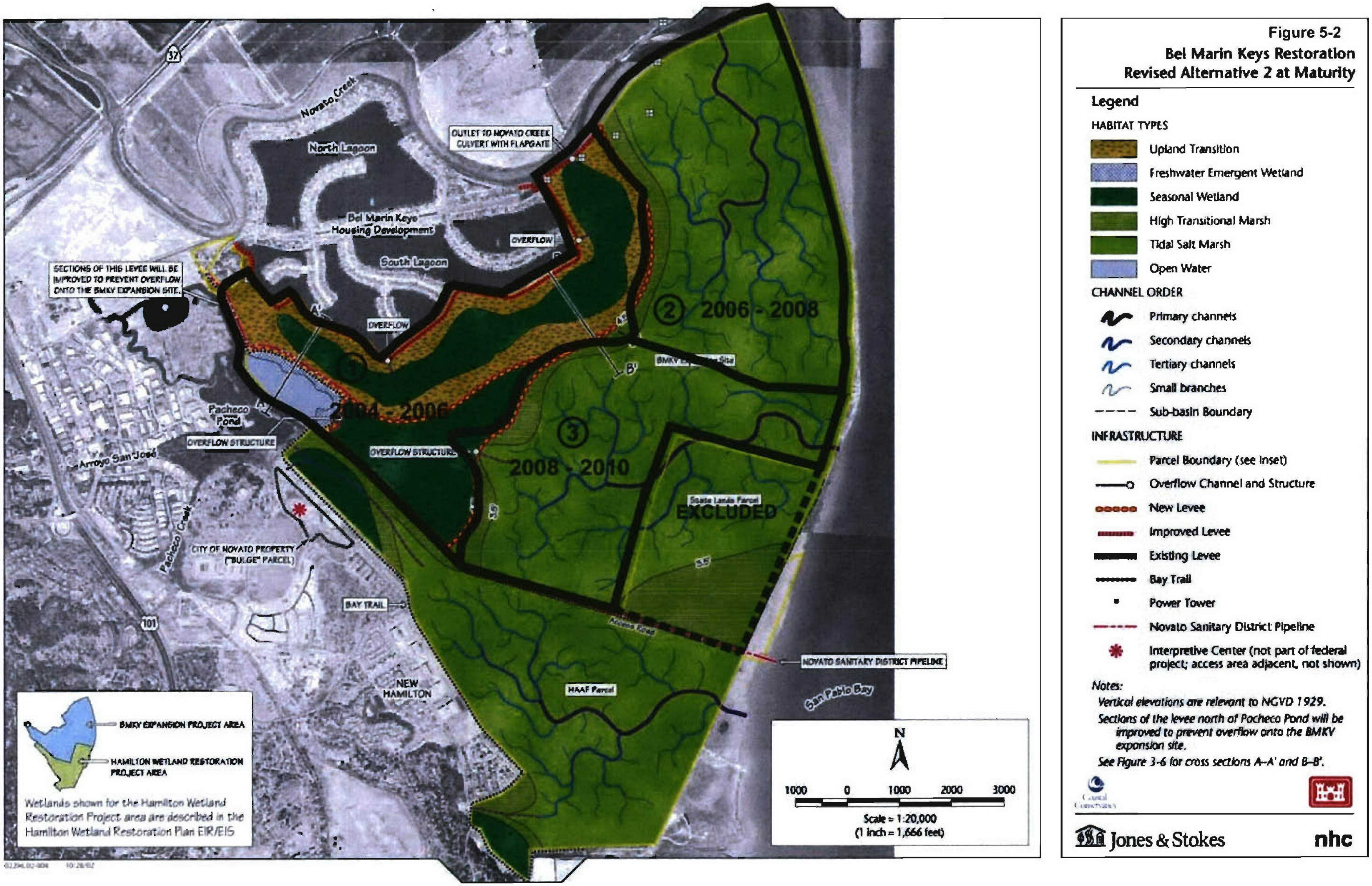
5.9.2.1 Construction Sequence A – BRAC Transfers and FUDS is Completed

This sequence assumes that both the BRAC parcel transfer and the FUDS action are completed in a timely manner (see Figure 5-1). Area 1- the tidal wetlands on the Hamilton Army Airfield are constructed from 2004 to 2006, primarily with O&M dredged material. Area 1 would likely be breached to tidal action in 2007 or 2008. Area 2 - the seasonal wetlands on Hamilton Army Airfield and the Navy Ball Fields parcels are constructed from 2005 to 2006, primarily with dredged materials from the Port of Oakland –50 foot Deepening Project. Area 3 - the seasonal wetland areas in BMKV are constructed from 2007 to 2009, primarily with O&M dredged materials. Area 4 - the northern tidal wetland cell at BMKV is constructed from 2010 to 2012, primarily with O&M dredged materials. Area 4 would likely be breached to tidal action in 2013 or 2014. Area 5 - the southern tidal wetlands cell at BMKV and the State Lands

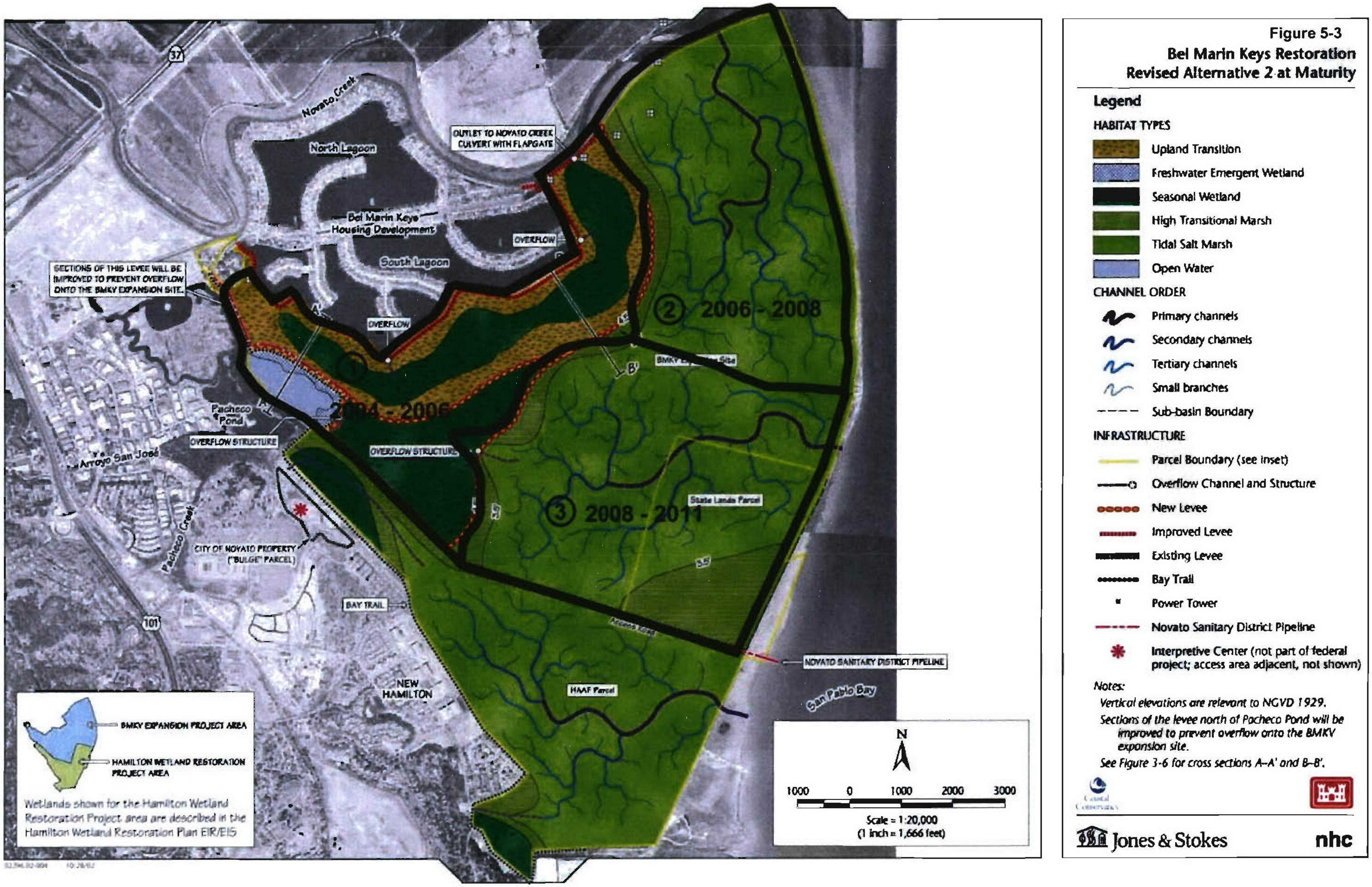
A. BRAC TRANSFERS AND FUDS IS COMPLETED



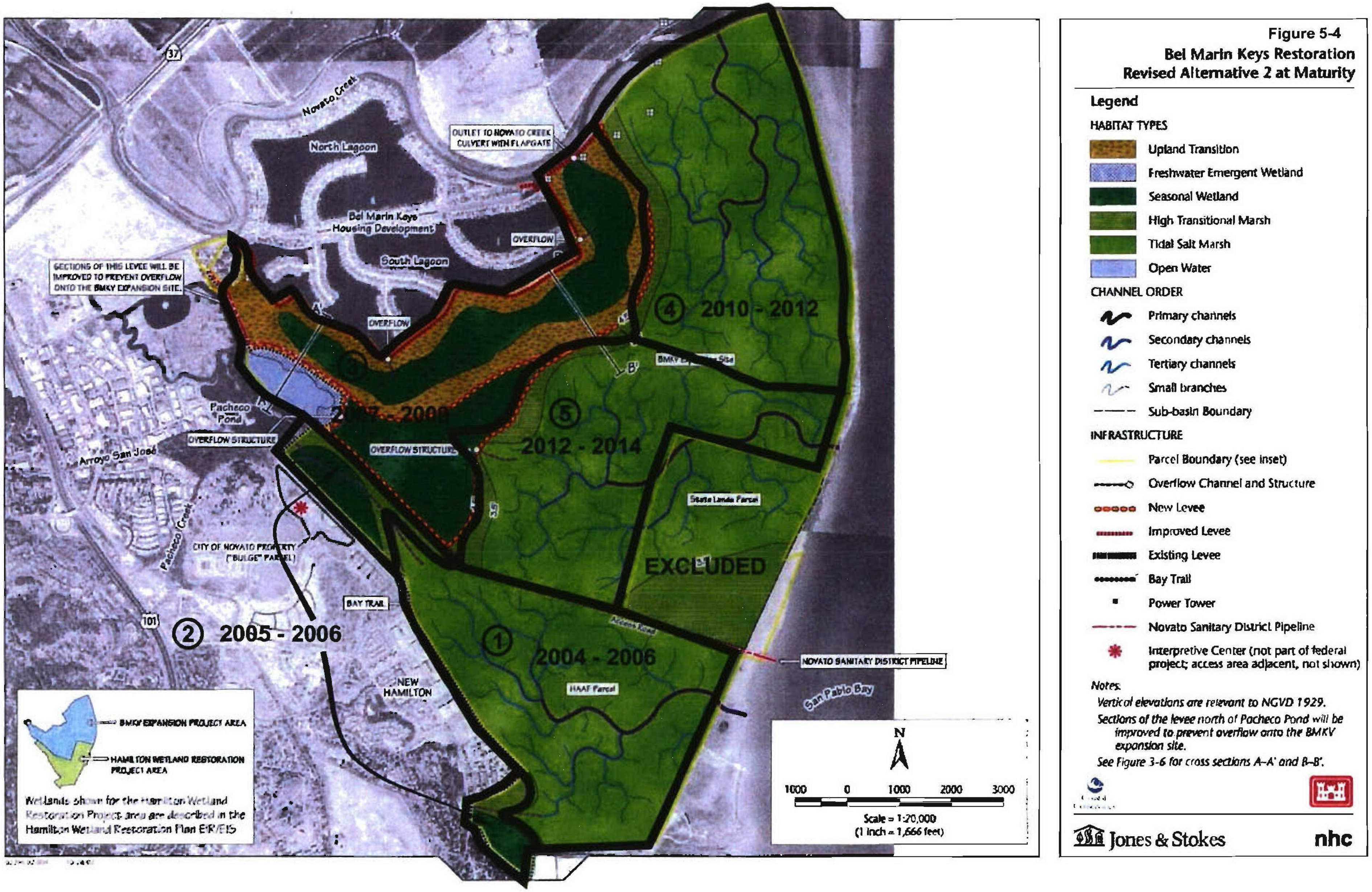
B. NO TRANSFER OF BRAC OR COMPLETION OF FUDS



C. FUDS COMPLETED, NO BRAC TRANSFER



D. BRAC TRANSFER, NO FUDS COMPLETION



Commission parcel is constructed from 2012 to 2015, primarily with O&M dredged materials. Area 5 would likely be breached to tidal action in 2016 or 2017.

5.9.2.2 Construction Sequence B - No Transfer of BRAC or Completion of FUDS
This sequence assumes that both the BRAC parcel transfer and the FUDS action are not completed in a timely manner and no construction occurs on these areas. Therefore, BMKV parcel is constructed without the Hamilton Army Airfield, Navy Ball Fields or State Lands Commission parcels (see Figure 5-2). Area 1- the seasonal wetlands on the BMKV parcel are constructed from 2004 to 2006, primarily with O&M dredged material and dredged materials from the Port of Oakland –50 foot Deepening Project. Area 2 - the northern tidal wetland cell at BMKV is constructed from 2006 to 2008, primarily with O&M dredged materials. Area 2 would likely be breached to tidal action in 2009 or 2010. Area 3 - the southern tidal wetlands cell at BMKV (without the State Lands Commission parcel) is constructed from 2008 to 2010, primarily with O&M dredged materials. Area 3 would likely be breached to tidal action in 2011 or 2012.

The Hamilton Army Airfield, Navy Ball Fields and State Lands Commission parcels could be constructed independently, after completion of the BMKV parcel, when the BRAC and FUDS actions are completed and the BRAC property transferred to the SCC.

5.9.2.3 Construction Sequence C – FUDS Completed, No Transfer of BRAC
This sequence assumes that the BRAC parcel transfer is not completed in a timely manner and no construction occurs on this area. Therefore, BMKV and State Lands Commission parcels are constructed without the Hamilton Army Airfield or Navy Ball Fields parcels (see Figure 5-3). Area 1- the seasonal wetlands on the BMKV parcel are constructed from 2004 to 2006, primarily with O&M dredged material and dredged materials from the Port of Oakland –50 foot Deepening Project. Area 2 - the northern tidal wetland cell at BMKV is constructed from 2006 to 2008, primarily with O&M dredged materials. Area 2 would likely be breached to tidal action in 2009 or 2010. Area 3 - the southern tidal wetlands cell at BMKV with the State Lands Commission parcel is constructed from 2008 to 2011, primarily with O&M dredged materials. Area 3 would likely be breached to tidal action in 2012 or 2013.

The Hamilton Army Airfield and Navy Ball Fields parcels could be constructed independently, after completion of the BMKV and State Lands Commission parcels, when the BRAC action was completed and the property transferred to the SCC.

5.9.2.4 Construction Sequence D – BRAC Transfers, FUDS Not Completed
This sequence assumes that the BRAC action is completed and the parcel transferred, however the FUDS action is not completed in a timely manner (see Figure 5-4). Area 1- the tidal wetlands on the Hamilton Army Airfield are constructed from 2004 to 2006, primarily with O&M dredged material. Area 1 would likely be breached to tidal action in 2007 or 2008. Area 2 - the seasonal wetlands on Hamilton Army Airfield and the Navy Ball Fields parcels are constructed from 2005 to 2006, primarily with dredged materials from the Port of Oakland –50 foot Deepening Project. Area 3 - the seasonal wetland areas in BMKV are constructed from 2007 to 2009, primarily with O&M dredged

materials. Area 4 - the northern tidal wetland cell at BMKV is constructed from 2010 to 2012, primarily with O&M dredged materials. Area 4 would likely be breached to tidal action in 2013 or 2014. Area 5 - the southern tidal wetlands cell at BMKV (without the State Lands Commission parcel) is constructed from 2012 to 2014, primarily with O&M dredged materials. Area 5 would likely be breached to tidal action in 2015 or 2016.

The State Lands Commission parcel could be constructed independently, after completion of the Hamilton Army Airfield, Navy Ball Fields and BMKV parcels, when the FUDS action is completed. However, due to very limited land access, along the NSD outfall pipeline access road the completion of FUDS and habitat restoration work on this site would likely be problematic and expensive.

5.9.3 Financial Capability of the Sponsor

The objective of this analysis is to conduct an initial financial assessment of the non-federal sponsor for the expansion of the HWRP to include BMKV. This initial assessment is intended to demonstrate that the cost sharing partner, the SCC, has successfully met its financial commitments in the past, has a variety of funding sources available to it, and has the capacity to ensure that the non-federal portion of the project funds will be available.

The total project implementation cost estimate for the Bel Marin Keys portion of the Selected plan is estimated to be approximately $182.7 million. Due to the unique relationship between HWRP and LTMS, the total project costs are shared among the non-Federal sponsor, the Federal government and navigation projects in the San Francisco Bay. Chapter 6 and Appendix A present the combined HWRP/BMKV project costs and cost-sharing.

Prior Corps Cooperation
The Conservancy has successfully cooperated with the Corps of Engineers on several previous occasions. Both Sonoma Baylands and the Napa Salt Marsh projects were sponsored by the Conservancy. The financial obligation of the sponsor with regard to both of these projects has been met in a timely and comprehensive manner. They have also met all of their financial obligations with regard to cost sharing the authorized HWRP. The successful participation and financial performance of the local sponsor in these and other non-Corps projects indicates the Conservancy's good faith effort to meet its financial obligations.

Funding Sources
The Conservancy's operation and programs are funded through a variety of sources. The budget is financed primarily through the State of California's General Fund. In addition supplemental funding for specific projects can be obtained from a variety of alternative sources. In any given year, these funding sources can include the following revenue generating vehicles:

1. Habitat Conservation Fund: The Conservancy is legislatively mandated to receive funds accruing to the Habitat Conservation Fund.

2. CALFED: A state and federal program to fund water resource and environmental conservation projects. The conservancy receives funds from CALFED for restoration projects.

3. Private Foundations and Individual Donations: The conservancy applies for and receives grants from a variety of entities. Some of the recent foundations committing funds to the Conservancy are the Marin Community Foundation (MCF) and the Hewlett Foundation.

4. State Grants: The Conservancy can receive and disburse funds from other state grant programs for coastal resource projects.

5. General Obligation Bonds: General Obligation Bonds offer the Conservancy another source of funds when required. The Conservancy can issue Bonds to finance habitat restoration projects. These General Obligation Bonds must be approved by California voters.

Financial Capability -Conclusion
At this time the local sponsor has a satisfactory financial position. The current federal and state policy emphasis on environmental restoration has resulted in increased funding and expanding budgets for restoration oriented agencies. This expansion of funding has been reflected in the conservancy's budgets over the last several years and is likely to continue. In addition, the SCC's access to alternative funding sources as indicated above is strong. In aggregate, the local sponsor appears to have the financial wherewithal to provide the funds for the non-federal project cost. These funds may or may not derive from debt instruments. The actual funding mechanism or combination of funding mechanisms to be used by the local sponsor will be determined before the PCA is modified.

5.9.4 Permits

Prior to project construction, the Corps would demonstrate that the project complies with the Clean Water Act. Project requirements would be coordinated with the RWQCB for compliance with requirements of the Act.

6.0 POST AUTHORIZATION SUMMARY

6.1 DESCRIPTION OF AUTHORIZED HWRP

Three parcels are included in the authorized project. They are the HAAF (644 acres), SLC (319 acres) and Navy Ball Fields (18 acres) parcels. These three parcels comprise the project area under the No Action plan.

6.1.1 Hamilton Army Air Field

The 644-acre airfield parcel lies on what was historically tidal marsh. Since being diked off in the early 20th century, the site has subsided to an average elevation of -5 feet NGVD. The airfield is protected from tidal inundation by a bayfront levee. The parcel would be acquired by the sponsor from the Army through the BRAC process. This parcel is an ideal candidate for tidal wetland restoration and is authorized.

6.1.2 Navy Ball Fields

The 18-acre Navy ballfield parcel abuts the airfield parcel at its southwestern corner. The parcel lies directly adjacent to a hillside (Long Point). Incorporation of this parcel in the restoration project would allow the use of the existing topography in the design. The levee would be tied into the hill, reducing the length of the levee required, thereby reducing the cost of the project. In addition, use of a natural border for the wetland would enhance the restoration by providing transitional habitat, and high tide refugia for marsh species that levee slopes do not provide. This parcel currently drains to the airfield. If this parcel were not included in the project, and a levee were to separate it from the airfield, it would be necessary to pump runoff over the levee in order to prevent ponding. This would incur an additional cost to the project. The Feasibility Report for HWRP states that the State Coastal Conservancy (SCC), who is the non-Federal sponsor (NFS), was to acquire the Navy Ball Fields property through a Public Benefit Conveyance (PBC) from the Navy. The Ball Fields are referred to as Ball Fields 3 and 4. The Navy is still awaiting the ROD to see what remedial action is needed for cleanup of this property prior to the PBC to the SCC. However, recently approximately two acres of these Ball Fields that are located south of the levee were assigned to the Department of Interior and subsequently quitclaimed to the City of Novato. The SCC will have to acquire fee title to a .69-acre of the portion of the Ball Fields that was quitclaimed to the City of Novato if these lands are to be included in the HWRP design.

6.1.3 State Land Commission Property

Formerly the Hamilton Antenna Field, this 319-acre parcel abuts the northeastern portion of the airfield and lies along the bayfront. Like the airfield, this area is historic tidal marsh. This parcel also has subsided significantly since being diked off. This parcel was transferred to the SLC during base closure. SLC is severely restricted under State law in transferring fee title of lands that they hold in public trust, and while under SLC

management and jurisdiction the parcel is subject to being outgranted for other (non-Project) uses, as long as that other use is consistent with the public trust. The standard estate for a wetlands restoration project is fee. The SLC is authorized to offer, under its own discretion, a lease to the SCC of up to 49 years; such a limited-term lease is unacceptable because it would not provide sufficient interest in the property to support the integrity of the Federal cost-shared project. The SLC could conceivably transfer fee title to the SCC via a legislative grant, but such a grant would be accomplished only at the discretion of the California legislature and, in any event, it would be incompatible with the plans of the parties, because the SLC would be effectively precluded from transferring fee title to the parcel to a public entity that would subsequently assume Project real property ownership and OMRR&R obligations, as the SCC intends to do. The following options, in lieu of the customary fee title estate that the non-Federal sponsor would normally be required to provide, have been researched and reviewed, and appear at this time as the most viable in resolving the real property interest requirements of the project while preserving the opportunity for the non-Federal sponsor to transfer its interests and responsibilities to a third party in the future: (1) the Federal Government would enter into condemnation proceedings to acquire this parcel at a later date when the property is required for construction, and would hold the parcel in federal ownership under the management of the Corps until the SCC arranges with a willing public entity an assumption of both OMRR&R responsibilities and ownership over the Project, at which time the federal title would be further transferred to that third party entity; or (2) a combination of all of the following: a 49-year lease from the SLC to the SCC and its successors, a single renewal of this initial lease at the option of the SCC or its successor (which the SCC or its successor will be required under the OMRR&R obligations to exercise), and listing of the SLC property on the California Significant Lands Inventory so as to preserve the property for uses fully consistent with Project purposes. These options have been discussed with the non-Federal sponsor and with SLC representatives, who have acknowledged the requirements and parameters of each option. Selection will be made from among all the available alternatives for resolution of the real property interest requirements of the project, at the time that the SLC parcel has been placed in a condition suitable for project implementation.

Antenna installations and associated cables are present on the SLC site. Other facilities on that site include aboveground fuel tanks, transformers, target practice ranges, and burn pits. These facilities are presently being investigated under the Formerly Utilized Defense Sites (FUDS) program prior to implementation of the wetland restoration project, and any remediation required to make the parcel suitable for ecosystem restoration purposes would be accomplished under the FUDS program prior to sediment placement.

6.1.4 Land Use

The Hamilton Wetlands Restoration project site was historically dominated by tidal salt marsh habitat but was converted to agricultural land in the late 1800s. In 1931 funds were appropriated for the construction of Hamilton Army Airfield, which was in operation until 1974. Currently the site consists of grasslands, seasonal and tidal

wetlands, and developed areas. The only remaining salt marsh in the project area is outboard of the levee that defines the developed portions of both the HAAF and SLC sites. Although the habitats present throughout most of the project site area are structurally simple (i.e., lacking the vertical structure that would be provided by trees and shrubs), a moderately large number of vertebrate species are present in this area, including some special-status species; however, relatively few species of reptiles and amphibians are present. Bird diversity is quite high, but the number of birds using the project site is limited. Species present include ducks, shorebirds, wading birds, passerines (perching, mainly song birds), and many species of raptors (birds of prey) that forage across the entire site.

Developed Areas
284 acres of the project site are developed areas consisting of concrete, asphalt, buildings, and bare ground. These areas provide minimal habitat for wildlife. The buildings were surveyed in 1997 for use by special-status bat species and none were present.

The developed areas of the parcel include a 6,000-foot runway, aprons, taxiways, an aircraft dispersal area, and twelve associated small outbuildings. The hangar is being removed as part of the Base Closure and Realignment Act (BRAC) process, while the remaining buildings will be demolished and removed by this project prior to restoration. In addition, a six-inch diameter fuel pipeline, formerly used to supply storage tanks that were present on the site, transects the airfield and extends 18,000 feet into the bay. This pipeline has been closed. The pipeline portion lying on upland area has been removed and the remaining portion lying in the bay has been abandoned in place.

A perimeter drainage ditch runs along much of the property line of the HWRP site. The ditch is classified as a jurisdictional water of the United States. Subdrainage pipes in three areas of the HWRP site discharge to the perimeter drainage ditch were installed to assist in lowering the water table. Three pump stations near the northeastern corner of the HWRP site discharge drainage from the perimeter ditch to a channel in the outboard tidal marsh. Power supply lines to the pump stations run along the outboard levee from the south. Drainage outlets from adjacent properties also lead into HWRP's perimeter drainage system.

A wetland mitigation site exists at the northern end of the runway. The 12.4-acre mitigation site was constructed to replace seasonal wetland losses resulting from Landfill 26 closure activities. The mitigation wetland is predominantly emergent marsh dominated by cattail, tules, and shallow open water. The existing wetlands at the HAAF and SLC parcels are described in more detail below.

A U.S. Army Corps of Engineers (USACE) certified wetland jurisdictional delineation of 87 acres on the HAAF site is in effect until February 23, 1999. A wetland delineation, identifying 16 acres of jurisdictional waters of the United States, was performed in January 1998 on the interior portions of the SLC site. The functions and values of the site are identified as part of a Habitat Evaluation Procedure conducted by the U.S. Fish and Wildlife Service (FWS).

Seasonal and Tidal Wetlands
The HAAF and SLC parcels contain both seasonal wetlands and tidal wetlands (coastal salt marsh and brackish marsh). The majority of the marsh at the HAAF and SLC parcels is high pickleweed marsh outboard of the perimeter levee. The total wetland acreage at the combined HAAF and SLC parcels is 159.5 acres.

Tidal Marsh
The project site includes 120 acres of high pickleweed marsh. There are 88 acres outboard of the developed portion of the HAAF site. Of this acreage, 66.3 acres are within the HAAF site boundary and the additional 32 acres are outboard of the SLC site. The pickleweed dominated tidal salt marsh along San Pablo Bay provides habitat for a number of bird species, including several special status species, dependent on such habitats, such as the California clapper rail. Shorebirds, generally present during winter as well as spring and fall migration, feed on mudflats at low tide or around the marshes adjacent to ponds and sloughs. Some water birds occur in both fresh water and saline wetlands, including dabbling ducks and wading birds. Although no surveys for the salt marsh harvest mouse have been conducted, it is likely that the tidal marsh supports a population of the mouse, and this study assumes that the species is present.

Seasonal Wetland
There are 35.5 acres of seasonal wetland on the HAAF project site. A total of 19.5 acres are on the HAAF site (including the 12.4-acre Landfill 26 wetland mitigation site) and 16 acres are on the SLC site. The dominant seasonal wetland species at the HAAF site are salt grass and alkali heath (*Frankenia salina).* Common wetland plant species on the SLC site include cattail (*Typha* spp.), salt marsh bulrush (*Scirpus maritimus*), and curly dock (*Rumex crispus*). Seasonal wetlands commonly provide high tide refugia (resting areas during high tide) for shorebirds. In addition, the aquatic invertebrates that inhabit the seasonal wetland pools provide forage for shorebirds.

Brackish Marsh
Cattail and bulrush colonize a total of 4 acres of marshy sections along the perimeter drainage ditch. Common species in the perimeter drainage ditch include threespine stickleback (*Gasterosteus aculeatus*), mosquito fish (*Gambusia affinis)*, and red-winged blackbirds.

Grassland
259 acres of the HAAF site (mostly in the revetment area) and nearly the entire SLC site are grassland. This habitat is dominated by ruderal (weedy) upland plants such as bristly ox-tongue (*Picris echioides*), yellow star thistle (*Centaurea solstitialis*), wild radish (*Raphanus sativa*), and curly dock (*Rumex crispus*). Additionally, non-native grasses such as Mediterranean barley (*Hordeum marinum*) and perennial ryegrass (*Lolium perenne*) are common throughout the project site. Grassland and ruderal vegetation around the project site supports relatively few bird species except where coyote bush (*Baccaris pilularis consanguinea*), blackberry (*Rubus* spp.), or patches of dense, tall herbaceous vegetation are present.

6.1.5 Special Status Species at HWRP

Table 6-1 lists the special-status wildlife species known to occur within the authorized HWRP project site. A complete list of potential special-status species is contained in the 1998 Hamilton Wetland Restoration Plan EIS. Four of the seven species utilize wetland habitat and two of the raptors forage in wetlands and grassland. A survey was conducted for special-status plant species and none were identified (USACE, 1996). No trapping has been conducted to determine the presence of the salt marsh harvest mouse; however, the study assumes that the mouse is present in the existing pickleweed marsh.

Table 6-1 Special Status Species Observed at Hamilton Army Airfield

Common and Latin Name	Status	Habitat
California clapper rail (*Rallus longirostris obsoletus*)	State and federal endangered	Cordgrass marsh, tidal sloughs
California black rail (*Laterallus jamicensis coturniculus*)	State threatened	Pickleweed marsh and grasses at edge of marsh
San Pablo song sparrow (*Melospiza melodia samuelis*)	State species of special concern	Tidal marsh
Salt marsh common yellowthroat (*Geothlypis trichas sinuosa*)	State species of special concern	Salt marsh and fresh water emergent marsh
Northern harrier (*Circus cyaneus*)	State species of special concern	Marshes and grasslands for foraging
Short-eared owl (*Asio flammeus*)	State species of special concern	Marshes and grasslands for foraging
Burrowing owl (*Spermophilus beecheyi*)	State species of special concern	Grassland with ground squirrel burrows

6.1.6 HTRW

The Hamilton Army Airfield has been in the Base closure process since 1974. Military uses of the property resulted in contamination with a number of substances, including relatively low levels of petroleum hydrocarbons, volatile and semi-volatile compounds, polychlorinated biphenyls, herbicides, pesticides and metals. Soils contaminated by Army activities on the HAAF parcel are concentrated around underground storage tanks (USTs), above ground storage tanks (ASTs), an aircraft maintenance facility, transformer and generator sites, a former sewage treatment plant, two burn pits, perimeter drainage ditch sediments, and coastal marsh sediments. A more detailed discussion of site contamination is provided in Chapter 10 of the HWRP EIS/R. This property was included in BRAC 1988. The U.S. Army is implementing a remediation program under the BRAC process to restore the airfield to a condition protective of human health and the environment for reuse as a wetland area, and is further coordinating its remediation technical studies with the State's efforts to restore a valuable wetlands ecosystem. The BRAC program's cleanup goals will be accomplished, in part, through the design and

implementation of the ecosystem restoration Project; thus, full remediation awaits completion of HWRP construction activities on the HAAF parcel.

The SLC parcel was also part of the military complex in the past and has more recently been used by the Novato Police Department for target practice. Assessment and investigation of the potential contamination in the SLC parcel has yet to be performed. Potentially contaminated sites include a rifle range, a former firefighting facility, a pistol range, a night firing range, transformers, and miscellaneous USTs and ASTs. Several unexploded grenades (expected to be practice grenades) were recently found on this parcel. The State Lands property is being remediated under the Formerly Used Defense Sites (FUDS) program. All contaminants on these properties will be remediated to a condition suitable for ecosystem restoration prior to site transfer. A combination of confirmatory sampling, toxicity testing, and ecological and human health risk assessments will provide information to determine final cleanup goals in a focused feasibility study.

The HAAF and SLC parcels have been the property of the military since 1930. Prior to that time they were farmed. Pre-WWII farming did not involve the use of significant contaminants and therefore there is no reason to believe that there are any potential concerns other than those resulting from the military use of the site, which is being addressed as part of the BRAC and FUDS efforts described previously. Soil samples taken by the Army to establish background levels of heavy metals at HWRP are consistent with this analysis.

6.2 AUTHORIZATION OF HWRP

The Hamilton Wetlands Restoration Project was authorized in Section 101(b) of WRDA 1999, which specifies:

"(b) PROJECTS SUBJECT TO A FINAL REPORT. The following projects for water resources development and conservation and other purposes are authorized to be carried out by the Secretary substantially in accordance with the plans, and subject to the conditions, recommended in a final report of the Chief of Engineers if a favorable report of the Chief is completed not later than December 31, 1999: . . . (3) Hamilton Airfield, California – The project for environmental restoration, Hamilton Airfield, California, at a total cost of 55,200,000, with an estimated Federal cost of $41,400,000 and an estimated non-Federal cost of $13,800,000."

The 1998 Hamilton Wetlands Restoration Project Feasibility Study was authorized by a resolution adopted by the United States Senate Committee on Environment and Public Works, dated October 29, 1997, that requested the Secretary of the Army to review the report of the Chief of Engineers on San Francisco Bay and Tributaries, California, dated December 21, 1976, and any other pertinent reports, with a view to determining whether any modification of the recommendations contained therein were advisable at that time, in the interest of ecosystem protection and restoration, including restoring tidal and

seasonal wetlands and related purposes, at the Hamilton Army Airfield and adjacent properties on San Pablo Bay, Marin County, California.

6.3 Funding Since Authorization

The following Federal funds have been appropriated for the HWRP since it was authorized in WRDA 99:

FY 00 $0.538 million GI
FY01 $2.126 million CG
FY02 $3.431 million CG

6.4 Changes in Scope of Authorized Project

A description and rationale of the changes in benefits and costs are presented in Chapter 4, Comparison of Alternatives. A summary is presented below:

Table 6-2 Comparison of HWRP and BMKV Benefits and Costs

	HWRP (as authorized in WRDA 99)	Proposed BMK V Expansion	Combined HWRP/BMK V Project	Percent Change
Restored Habitat (acres)	950	1576	2526	166%
Dredged Material Placement Capacity (mcy)	10.6	13.8	24.4	130%
Average Annual Habitat Units	350	526	876	150%
Total Project Implementation Cost ($ Million)	119.0*	182.7	301.7	154%

*Authorized at a cost of $55.2 million, updated to include offloader standby costs and excess transportation costs, as well as inflation and increased utility costs (see Section 6.9.2).

6.5 Changes in Project Purpose

The authorized project purpose was environmental restoration. The recommended combined HWRP/BMK V project will include recreation as a project purpose.

6.6 Changes in Local Cooperation Requirements

Section 8.2 presents a list of local cooperation requirements. An item of local cooperation has been added to require the sponsor to provide 50 percent of all costs associated with recreation features.

6.7 Change in Location of Project

There are no changes in location of the authorized project. Reauthorization to add the BMKV parcel would extend the authorized project boundaries northward to include an additional 1,610 acres. Addition of 2 acres of the 'Bulge' parcel would extend the authorized project boundary to the southwest.

6.8 Design Changes

The expansion of the HWRP to include the BMK V parcel would result in minor changes to the authorized HWRP and would not be a separable expansion project. The changes associated with the preferred alternative for BMK V expansion would include:

1) replacing the barrier levee between the HWRP site and the BMKV parcel with an access berm for the NSD outfall,
2) elimination of the levee between the SLC parcel and the BMKV parcel,
3) change in location and increase in high transitional marsh on the SLC parcel, and
4) repositioning of the SLC parcel levee breach, to restore tidal flow, onto the BMK V parcel,
5) addition of an access area for approved recreation features, and
6) potential use of diesel off-loading and booster pumps for off-loading dredged material.

These changes assume that the authorized HWRP site will be available for construction prior to initiation of construction of the BMK V expansion parcel. The project design is presented in Chapter 5 of this report.

6.9 Changes in Total Project First Costs

Appendix A provides a detailed discussion of changes in total project first costs. A summary of the changes is provided below.

6.9.1 LTMS and HWRP Costs

The relationship between LTMS costs and HWRP project costs is described below.

The members of the Long Term Management Strategy (LTMS) Executive Committee signed and approved the Final LTMS Management Plan in January 2002. The members of the Executive Committee include the Corps of Engineers, the Environmental Protection Agency, the San Francisco Bay Regional Water Quality Control Board, the San Francisco Bay Conservation and Development Commission, and the State Water Resources Control Board. The Final LTMS Management Plan reduces the allowable in-bay disposal volumes of dredged material by more than 50% compared to pre-LTMS volumes. Implementation of LTMS will require that much of the dredged material that

has historically been placed in the bay be placed in upland sites or in the ocean. Other than the small volume that the smaller navigation projects will continue to be allowed to dispose of in-Bay, dredged material disposal will be evenly allocated between upland and ocean sites, and full allocation to upland or ocean disposal will be phased in over 12 years.

Presently, the LTMS Implementation Plan is not mandating any upland disposal, but has designated ocean disposal for some navigation projects and will be designating disposal at the San Francisco Deep Ocean Disposal Site (SFDODS) for other projects as the implementation transition period proceeds. Thus, implementation of LTMS will have no immediate impact on the disposal costs of those projects presently disposing at the ocean site. However, since in-bay disposal is the least costly alternative, implementation of LTMS will increase the cost of navigation improvements and associated maintenance for the projects currently using in-bay disposal sites that will instead place dredged material upland or at the ocean site under the LTMS Implementation Plan. The magnitude of the post-LTMS cost increase will vary from project to project, and will depend on the location of the present disposal site and whether the new disposal destination is upland or in the ocean. Upland sites must be developed to accommodate the new disposal strategy, and the cost to develop these sites for Federal projects will be funded, at least in part, by the Corps' navigation construction and O&M programs.

Authorized HWRP Incremental Costs

The HWRP was authorized in WRDA 1999 at a cost of $55.2 million. Project features included preconstruction engineering and design (PED), site preparation, and material offload and placement costs for 10.6 million cubic yards (mcy) of material to be placed at the HWRP site.

Table 6-3 Authorized HWRP Costs ($ million)

1998 Hamilton Project Cost (excluding Bel Marin Keys expansion)	
	HWRP WRDA '99 Cost (1998 $)
Lands, Easements and Rights of Way	0.3
Relocations	2.1
PED & Construction Mgmt	4.1
Site Preparation	20.8
Navigation Ports & Harbors	27.8
Total	55.2

1/ The Project Cooperation Agreement (PCA) defines the 902 Limit as $72.4 million.

As described above, implementation of LTMS will have no immediate impact on disposal costs for those navigation projects presently disposing at the ocean site. However, those navigation projects currently disposing at in-bay sites for which disposal designations will change under LTMS implementation will have to either pay higher transportation costs to take material to the ocean or additional costs to place material in upland sites. The HWRP

was authorized to fund the "incremental cost of transportation and disposal of dredged material." This Hamilton incremental cost is defined, in paragraph 6 of the Chief's Report, as the value by which the costs of transportation and disposal of dredged material to the HWRP exceed the costs of transportation and disposal at the least-cost environmentally acceptable disposal alternative. This authority effectively allows the HWRP to share the LTMS incremental cost with the navigation projects. Refer to Appendix A for further explanation of incremental costs.

More navigation projects will be shifted from in-bay to ocean disposal as LTMS implementation is gradually phased in. Those projects must assume the additional costs associated with LTMS implementation, regardless of whether the HWRP is an available disposal option or not. For example, the Oakland Harbor maintenance project and the Richmond Harbor maintenance project must now pay the costs of SFDODS disposal as their least-cost environmentally acceptable disposal option. The fact that the HWRP presents a beneficial reuse opportunity at no extra premium provides those projects the incentive to choose to place material at Hamilton in lieu of offshore disposal. The costs of SFDODS disposal, for the Oakland and Richmond maintenance projects, constitute a minimum fixed cost, from this point forward.

6.9.2 Post-WRDA HWRP Implementation Cost Adjustments

In anticipation of the reauthorization of the HWRP to add the BMK V parcel, the design team has revised the original WRDA 1999 project cost for HWRP to reflect the cost increases associated with inflation, utility relocations, offloader standby costs, and excess transportation costs.

<u>PED and Site Preparation</u>

PED (including construction management) costs were adjusted from 1998$ to 2002$ as shown below. These costs were adjusted to account for the lengthy construction period, required overtime and changed labor rates. Costs were added to PED for value engineering studies. Site preparation costs were adjusted to reflect current conditions and adjusted for inflation.

Table 6-4 PED 1/ Costs ($million)

1998$	Inflated to 2002$
4.1	16.3

1/ includes construction management costs

Table 6-5 Site Preparation Costs ($ million)

	1998$	Inflated to 2002 $
Site Prep	19.3	19.6
Adaptive Management	1.5	2.8

Utility Relocation Costs

The HWRP feasibility study assumed that the existing Novato Sanitary District outfall could be protected during construction by slip-lining the pipeline and leaving it in place during construction. However, PED investigations have indicated that a much longer portion of the pipeline would require slip-lining, thus increasing the costs beyond the point of being cost-effective. It was concluded that the most cost-effective method to protect the existing outfall pipeline would be to replace it in-kind with an adjacent plastic (HDPE) pipeline. The utility relocation cost increased as a result of this analysis.

Table 6-6 Utility Relocation Costs ($ million)

1998$	Increased Utility Costs	Adjusted Cost 2002$
2.1	+10.5	12.6

Offload/Placement Costs

The WRDA 1999 HWRP costs included a line item for "Navigation Ports and Harbors" that accounted for offload and placement costs and that was based on an average cost of $2.62/cy. For clarity, this line item has been broken out into offload/placement costs and excess transportation costs.

The offload/placement costs were computed for the combined HWRP/BMK V project and then the HWRP and BMK V proportionate shares of these costs were calculated based on the volume of material that would be required for the HWRP and for the BMK V addition. Appendix A presents the data that were used to compute the offloader mobilization/demobilization and operational costs. Columns "K" and "L" of Table A-1 of Appendix A display the unit costs associated with these activities. These unit costs were multiplied by the volume of material to be delivered to the combined HWRP/BMK V project to compute the total offloader operating and mobilization/demobilization cost, shown in column "O". This cost was then added to the following offloader construction and standby costs to compute the total offload cost for the combined project.

Table 6-7 Total Offload Costs for the Combined HWRP/BMK V Project

offload operating and mob/demob (Table A-1 column "O")	$ 71.0
offloader platform/pipeline/electrification	$ 6.6
offloader equipment standby	$ 17.8
offloader labor standby	$ 21.5
Subtotal	$ 116.9
contingency	$ 13.2
Total	**$ 130.1**

Note: The Hamilton feasibility study assumed that the offloader mechanism would operate continuously throughout the construction period. However, the revised design assumes that the offloader will be in a standby mode for approximately 15 to 20% of the

project construction period. Offloader equipment and operators must be paid during this standby time. These standby costs were not accounted for in the original feasibility cost estimate.

Table 6-8 Offload/Placement Costs ($ million)

1998$	2002 $ Adjusted Cost
27.8	54.4

Excess Transportation Cost

As discussed in greater detail in the sub-section entitled "Excess Transportation Costs Associated with the Shift from In-Bay to HWRP Disposal," contained in section 6.9.1 of Appendix A, Federal and non-Federal navigation projects that presently dispose of dredged material at in-Bay sites would incur additional transportation costs to dredge and transport material to Hamilton instead of to their designated in-Bay sites. In each of these cases, the HWRP will fund this "excess transportation cost" of hauling the material to Hamilton. The excess transportation cost has been computed based on the volume of material expected to be delivered from each of the applicable navigation projects over the life of the HWRP. As many of the remaining individual in-bay projects shift from to SFDODS disposal during implementation of LTMS, the excess transportation cost will be eliminated, and the projects will instead pay to the HWRP the transportation cost differential as described in the sub-section entitled "Differential Costs Associated with the Shift from Ocean to HWRP Disposal," contained in section 6.9.1 of Appendix A.

The LTMS Implementation Plan requires that in-bay disposal gradually shift to ocean or upland disposal over a 12-year period. Because the LTMS navigation project-by-project schedule has not yet been developed for those projects still disposing of dredged material in-Bay, assumptions were made regarding projected LTMS implementation for the purposes of computing excess transportation costs for the HWRP. Refer to Appendix A for a more detailed discussion of these assumptions.

The adjustments to the HWRP costs define the total HWRP implementation costs if the HWRP were to be constructed without the BMK V expansion. These costs are shown below:

Table 6-9 Adjusted Total HWRP Implementation Costs ($million)

	Total Project Cost (1998$)	Adjusted Total Project Implementation Cost (2002$)
Lands and Damages	0.3	0.4
Relocations	2.1	12.6
PED/Construction Management	4.1	16.3
Site Prep	19.3	19.6
Navigation Ports & Harbors	27.8	n/a
Offload/Placement	n/a	54.4
Excess Transportation Costs	n/a	12.9
Adaptive Management	1.5	2.8
Total	55.2	119.0

6.9.3 Oakland Deepening Project Contribution to HWRP Implementation Costs

The HWRP and the Oakland –50 Foot Deepening Project were both authorized in WRDA 1999. WRDA 1999 authorized both projects to place Oakland dredged material at the HWRP. The HWRP was authorized to share site preparation and offload/placement costs with navigation projects using the site, by accepting funding contributions from the Oakland Deepening Project, among others. The Oakland Harbor Navigation Improvement (-50-Foot) Project Cooperation Agreement (PCA), which was signed in July of 2001, requires the Oakland Project to contribute 100% of the PED, site preparation, and offload/placement costs associated with placing that volume of material dredged from the Deepening Project and delivered to the HWRP, which the Oakland Project authorization estimated at 2.5 mcy. This requirement does not apply to Oakland maintenance material.

The Oakland Deepening Project is generally assigned the funding responsibility for approximately 25% of the costs of beneficial use at the HWRP; of this proportion, the Oakland PCA estimates that the Oakland Project's share of the Hamilton site preparation costs (not including Hamilton's offload and placement costs) will be $5.2 million. The Oakland contributions are based on the following assumptions:

a. The Oakland Project will deliver all 2.5 mcy to HWRP.
b. The Oakland Project's share of costs is computed based on its proportional contribution to total cubic yardage delivered to the HWRP site (2.5 mcy/10.6 mcy = 23.58%).
c. The Oakland Project is expected to contribute 23.58% of the estimated total volume of dredged material to be placed on the HWRP site. A 23.58% fraction of the site preparation, PED and construction management, relocations, lands and damages, and offload/placement costs has been calculated for attribution to the Oakland Project. The Oakland Project is not responsible for paying any portion of excess transportation costs associated with other navigation projects.

Based on the adjusted total HWRP implementation costs, the Oakland Deepening Project will contribute approximately $25 million toward the HWRP costs, leaving the remaining $94 million to be funded by the HWRP and other navigation projects using the site.

Table 6-10 Oakland Deepening Project Contribution to HWRP Total Project Implementation Cost ($million)

	Adjusted Total HWRP Implementation Cost (2002$)	Oakland Deepening Project Contribution (2002$)
LERs	0.4	0.1
Relocations	12.6	3.0
PED & Construction Costs	16.3	3.8
Site Prep	19.6	4.6
Offload/Placement	54.4	12.8
Excess Transportation Costs	12.9	N/A
Adaptive Management	2.8	0.7
Total	119.0	25.0

6.9.4 Total Implementation Costs for Combined HWRP and BMK V Project

The following table displays the estimated total project implementation costs for the combined HWRP/BMK V project. The figures for the BMK V portion are presented in Chapter 5 of this report.

Table 6-11 Total Project Implementation Costs ($million) (2002$)

	HWRP	BMK V	Combined Project
LERs	0.4	19.4	19.8
Relocations	12.6	0.3	12.9
PED & Construct. Mgmt	16.3	22.4	38.7
Site Prep	19.6	40.4	60.0
Offload/Placement	54.4	79.6	134.0
Excess Transport. Cost	12.9	16.7	29.6
Recreation	0.0	0.2	0.2
Adaptive Management	2.8	3.7	6.5
Total	119.0	182.7	301.7

6.9.5 Other Navigation Project Contributions to HWRP/BMK V Combined Project Implementation Costs

The total project implementation costs for the Combined HWRP/BMK V Project will be funded through the HWRP/BMK V Project, the Oakland Deepening Project, and the other navigation projects using the project site. The Oakland Deepening Project's contribution is estimated to be $25 million, as detailed above.

Those other Federal and non-Federal navigation projects designated under the LTMS Implementation Plan to dispose of dredged material at SFDODS will contribute funding

to the HWRP. The funding contribution will be calculated as a cost differential: the difference between the estimated costs of dredging, transportation to and disposal at SFDODS, and the actual costs of dredging and transportation to Hamilton. The schedule of material to be delivered to the site from other navigation projects is provided in Table 2 of Appendix A. These quantities were used to compute the funding contribution to the HWRP from navigation projects presently disposing of dredged material at SFDODS.

The total project implementation cost for the combined project is the cost to design and construct the project, including dredged material transportation costs that exceed current dredged material hauling costs as described in this chapter. Total project implementation costs will be shared by the non-Federal sponsor, navigation projects in the San Francisco Bay (both Federal and non-Federal), and the Federal Construction General program. See Appendix A for a more detailed explanation of total project implementation costs and total first project costs.

The total project implementation cost for the combined Hamilton Wetland Restoration Project and Bel Marin Keys Expansion project is estimated to be $301,700,000 to be funded as follows: non-Federal sponsor: $47,100,000, Federal and non-Federal navigation projects: $113,400,000, and Federal Construction General funds: $141,200,000.

The navigation projects' contributions must be subtracted from the total project implementation cost to determine the total project first cost. As is more fully discussed in Appendix A, this is necessary to avoid redundant Federal appropriations covering identical components of both the HWRP and other Federal navigation projects, and to account for contributions to the HWRP's total project implementation costs derived from non-Federal navigation projects providing funding to the HWRP as determined by those projects' transportation costs differential. The total project first cost defines the Congressionally authorized project cost.

The total first project cost for the combined project is $188,300,000 under fourth quarter 2002 prices; this figure will form the basis of cost-sharing. The Federal share is currently estimated at $141,200,000. The non-Federal share is currently estimated to be $47,100,000.

Table 6-12 Total Project First Costs ($million)

Total Project Implementation Cost for Combined Project	Oakland Project's Contribution	Other Navigation Project Contributions	Total Project First Cost
$301.7 million	$25.0 million	$88.4 million	$188.3 million

6.9.6 Changes to Total Project First Costs for Combined HWRP and BMK V Project

The following table displays the estimated costs for the combined HWRP/BMK V project, the HWRP project as authorized by WRDA 1999, the authorized project updated to current price levels, and the project last recommended to Congress.

Table 6-13 Changes in Total Project First Costs ($million)

Recommended Project Costs (2002 $)	Authorized (WRDA 99) (1998 $)	Updated Authorized Costs (2002 $)	Costs Last Presented to Congress (2001$)
$188.3	$55.2	$119.0 1/	$63.2

1/ The updated authorized costs presented here are the HWRP adjusted project implementation costs.

6.10 CHANGES IN PROJECT BENEFITS

Refer to Section 6.4 above for a summary of changes in project benefits.

6.11 BENEFIT-COST RATIO

There is no benefit-to-cost ratio for this project since it is an environmental restoration project.

6.12 CHANGES IN COST ALLOCATION

The table below shows the allocation of costs between the two project purposes for the authorized project and the recommended project. These costs reflect total first project costs, as defined for cost-sharing purposes, rather than total project implementation costs.

Table 6-14 Changes in Cost Allocation (2002$, $million)

Project	Restoration	Recreation	Total Cost	% Allocated per Purpose
HWRP (WRDA 99)	55.2	0	55.2	100% Restoration
Combined HWRP/BMK V	188.1	0.2	188.3	99.9% Rest./0.1% Recr.

6.13 CHANGES IN COST APPORTIONMENT

The following table shows the Federal and non-Federal share of the total first costs for the recommended combined project at current price levels.

Table 6-15 Combined Total First Project Costs (2002$, $million)

FIRST COST	FEDERAL	NON-FEDERAL	TOTAL
Subtotal Restoration	141.1	47.0	188.1
Recreation	0.1	0.1	0.2
Total	141.2	47.1	188.3

6.14 ENVIRONMENTAL CONSIDERATIONS IN RECOMMENDED CHANGES

A Supplemental EIR/S has been prepared and is attached to this report. All environmental effects are presented in that analysis.

6.15 PUBLIC INVOLVEMENT

See Chapter 7 for a discussion of the public involvement process for the BMKV expansion study.

6.16 HISTORY OF PROJECT

The HWRP was authorized for construction in WRDA 1999. The PED phase is underway for the HWRP. The PCA was signed by the Army and the California Coastal Conservancy on 22 April 2002. Construction of a $1.2 million portion of the dredged material delivery pipeline was completed in February 2002 as part of the Oakland Project's site development requirements under the terms of the Oakland Project PCA.

7.0 PUBLIC INVOLVEMENT

7.1 REPORT CIRCULATION, PUBLIC MEETINGS AND WORKSHOPS

To announce the start of the feasibility phase, a Public Notice was issued to residents, federal, state and local agencies and interest groups. The recipients were invited to provide input into the feasibility-level study, including the scoping of the environmental issues that should be addressed throughout the study. The notice announced two public meetings, held by the Corps and the State Coastal Conservancy, which also served as SEIS/R scoping meetings. The meetings were conducted on September 25, 2001 and December 5, 2001.

The Draft General Reevaluation Report was released on July 19, 2002. A 45-day public review and comment period follows the release to solicit comments from the public, regulatory agencies, local interests and other stakeholders. On August 21, 2002, a public meeting was held to solicit any additional comments. Due to difficulties in accessing the document at least one public repository, the public review period was extended by 10 days to September 13, 2002.

7.2 GENERAL REEVALUATION STUDY INVOLVEMENT

7.2.1 Institutional Involvement

During the feasibility-level study for the GRR, coordination with the FWS was conducted in accordance with the Fish and Wildlife Coordination Act. The FWS has expressed support for the project; a letter dated May 16, 2002 and a letter dated September 30, 2002 are attached as Appendix H. The FWS provided the Corps with a Draft Coordination Act Report (DCAR) in February 2003. This document is currently in review. The FWS will coordinate the DCAR with the NMFS and the California DFG.

7.2.2 Study Team

During the feasibility-level study for the GRR, staff from the SCC and BCDC participated in the study's technical team and contributed directly in the study effort. As a result of this involvement, the SCC and BCDC have expressed their interest in their participation as study team members during the Pre-construction, Engineering and Design phase.

7.2.3 Hamilton Restoration Group

The Hamilton Restoration Group (HRG), a forum for a variety of interests to provide input on project feasibility, goals, design, and other relevant issues, was established by the National Marine Fisheries Service in the summer of 1995. The lead was handed to the Coastal Conservancy in 1996. Participants in the HRG include the Coastal Conservancy, BCDC, City of Novato, California Regional Water Quality Control Board,

California Department of Fish and Game, National Marine Fisheries Service, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, Port of Oakland, University of California, environmental groups, interested public, and congressional representatives.

7.2.4 Coastal America Partnership

This project is also part of the Coastal America Program. In 1992, the Coastal America Partnership was created to more effectively address critical coastal environmental problems facing our nation. It leverages the resources, expertise, and authorities of the federal natural resource, infrastructure, and military agencies with state, local, tribal, and non-governmental organizations. Federal agencies coalesced to form this partnership focused on habitat restoration, sediment contamination remediation, and non-point source pollution prevention within coastal areas. A national implementation team was established along with eight regional implementation teams. Member agencies include: U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Geological Survey, U.S. Environmental Protection Agency, Department of Transportation, U.S. Air Force, U.S. Navy, U.S. Army, Department of Energy, Department of Housing and Urban Development, and Department of Agriculture. Over 250 projects are either underway or completed.

In April 1995, the National Marine Fisheries Service recommended to the Southwest Implementation Team for Coastal America that the base closure at the Hamilton Army Airfield and the potential for nearly 700 acres of wetland restoration be endorsed as a "Coastal America" project. The wetland restoration proposal was based on wetland reuse as recommended by the Hamilton Reuse Planning Authority and adopted by the City of Novato. The Coastal America partnership served as a catalyst in linking Federal, state, regional, and local interests in the base closure, wetland restoration, and dredged material placement from navigation projects in the San Francisco Bay area.

7.2.5 Public and Agency Involvement

Input from members of the public, organizations with an interest in the project, and local, state and federal agency staff was an essential component of the planning process for this Hamilton Wetland Restoration GRR to incorporate BMK. Tools used to introduce members of the public and interested agencies and organizations to the project and to solicit input included: interviews with stakeholders and technical consultants; Technical Information Committee (TIC) meetings; and public meetings. North Marin Water District participated as a stakeholder in the HWRP group meetings.

7.2.5.1 Stakeholder Interviews

In late August and early September 2001, a series of interviews was conducted with staff of local, state, and federal agencies, and technical consultants who were previously involved with the Hamilton wetland restoration project or had knowledge or experience relevant to the BMKV project site. The interviews covered a range of topics that were organized into 4 general categories: (1) general restoration planning goals and

objectives; (2) site-specific questions; (3) site-specific restoration planning issues; and (4) the public participation process. An Issue Audit Memorandum summarizing the results of the interviews was prepared to guide the initial phase of the planning process (Appendix B of Bel Marin Keys Conceptual Restoration Design Technical Report, attached).

7.2.5.2 Technical Information Committee Meetings

As a follow-up to the interview process, two meetings of the Technical Information Committee (TIC) were held with the interview participants and other interested individuals, in order to further clarify planning issues and solicit input on alternative restoration concepts. The TIC meetings were held on October 2, 2001 and November 6, 2001. Key planning issues identified by the TIC at the October 2 meeting included the following:

- Flood protection for adjacent properties;
- Sediment deposition in Novato Creek;
- Diversity of target restoration habitats and the need to achieve appropriate post-restoration habitat mix;
- Integration with Pacheco Pond, Arroyo San Jose, and Pacheco Creek;
- Marin County flood protection easements and covenants;
- Vector control;
- Integration with adjacent Hamilton Wetland Restoration Project; and
- Long-term management requirements.

The November 6th TIC meeting focused on reviewing a series of alternative restoration concepts developed for the project site. Key issues associated with the alternatives discussed at the meeting included the following:

- The reasonable range of alternatives (e.g., inclusion of an alternative that does not rely on placement of dredged material as fill);
- Alternative alignments for the Novato Sanitary District outfall line;
- Alternative Bay Trail alignments;
- Flood protection concerns;
- Potential impacts on existing habitats;
- Historic conditions; and
- Habitat mix and viability, including the source of water for seasonal wetlands.

7.2.5.3 Public Meetings

During the restoration planning process, the project team held three public meetings to introduce interested members of the public to the project and to solicit public input. These meetings were held on September 25, 2001, December 5, 2001, and August 21, 2002. The initial public meeting provided the public with an opportunity to meet the project sponsors, to review and discuss the project goals and objectives, and to provide input on site-related opportunities and constraints. The second public meeting provided a forum for discussion of alternative restoration concepts and potential environmental issues, and served as a formal scoping meeting for the environmental compliance process. Public comments received at these meetings were recorded for consideration during the restoration planning process. In addition, participants at the second public meeting were encouraged to submit written comments to the project sponsors during the 30-day public comment period. Issues of concern identified through the public scoping process included:

- flood protection,
- public access to the project area,
- potential impacts on Novato Creek, and
- impacts on existing biological resources.

Appendix D and Appendix F, presented as part of the Technical Appendices attached to this General Reevaluation Report, contain a more detailed summary of issues identified during the public scoping process.

The third public meeting provided a forum for discussion of the preliminary alternatives and served as a formal meeting for the environmental compliance process. Participants were encouraged to submit written comments during the 45-day public review period. Additional issues of concern identified during this period were: include:

- navigation in Novato Creek,
- flood insurance,
- scenic views from adjacent residences,
- traffic, and
- public health (particularly mosquito breeding habitat).

With the exception of flood insurance, all of these key additional issues were discussed in the draft SEIR/EIS. Discussion of flood insurance has been added to the final SEIR/EIS.

Formal responses to comments are presented in a separate volume, *Responses to Comments, Final Supplemental Environmental Impact Report/Environmental Impact Statement Bel Marin Keys Unit V Expansion of the Hamilton Wetland Restoration Project*, California State Coastal Conservancy and U.S. Army Corps of Engineers, November 2002.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

Major conclusions of studies conducted to date are:

- The tentatively recommended plan is economically feasible.
- The prospective non-Federal sponsor fully supports the project. The non-Federal sponsor has purchased the BMK V parcel in anticipation of project implementation.
- The Financial Analysis completed for the HWRP indicates that the non-Federal sponsor is financially capable of participating in the selected plan.
- The non-Federal sponsor fully understands the cost-sharing requirements for project construction and the responsibility for operation, maintenance, rehabilitation, relocation, and repair for the project.
- The tentatively recommended plan fully meets the Federal and non-Federal sponsor's ecosystem objectives.
- The reauthorization of the HRWP is justified by the increased and adjusted project implementation costs.

8.2 Recommendations

In making the following recommendation herein, I have considered all significant aspects in the overall public interest, including environmental, social and economic effects; engineering feasibility; and regional needs.

I recommend that the wetland restoration project at the Hamilton Army Airfield, City of Novato, Marin County, California, be reauthorized at the funding level described herein, and that the expansion of the project, as also described herein, be authorized for implementation as a Federal project. I recommend that the modified project be authorized subject to cost sharing as required by Public Law 99-662, the Water Resources Development Act of 1986, as amended.

The total project implementation cost for the combined project is the cost to design and construct the project, including dredged material transportation costs that exceed current dredged material hauling costs as described in Chapter 6 of this report. Total project implementation costs will be shared by the non-Federal sponsor, navigation projects in the San Francisco Bay (both Federal and non-Federal), and the Federal Construction General program. For ecosystem restoration projects, the Federal share is 65%, while the non-Federal share is 35%. If beneficial

reuse of dredged material is achieved, as in the Selected Alternative, the Federal share increases to 75%, while the non-Federal share decreases to 25%. In accordance with the US Army Corps Policy Guidance Letter 59, the cost of justified and approved recreation features will be cost shared at 50% Federal and 50% non-Federal, provided the Federal cost is not increased by more than 10%.

The total project implementation cost for the combined Hamilton Wetland Restoration Project and Bel Marin Keys Expansion project is estimated to be $301,700,000 to be funded as follows: non-Federal sponsor: $47,100,000, Federal and non-Federal navigation projects: $113,400,000, and Federal Construction General funds: $141,200,000.

The navigation projects' contributions must be subtracted from the total project implementation cost to determine the total project first cost. This is necessary to avoid redundant Federal appropriations covering identical components of both the HWRP and other Federal navigation projects, and to account for contributions to the HWRP's total project implementation costs derived from non-Federal navigation projects providing funding to the HWRP as determined by those projects' transportation costs differential. The total project first cost defines the Congressionally authorized project cost.

The total first project cost for the combined project is $188,300,000 under fourth quarter 2002 prices; this figure will form the basis of cost-sharing. The Federal share is currently estimated at $141,200,000. The non-Federal share is currently estimated to be $47,100,000. I recommend that the Corps of Engineers participate in cost-shared monitoring and minor modifications that may be required to ensure the success of the project, as identified by the success criteria outlined within the Monitoring and Adaptive Management Plan.

The implementation cost of the Bel Marin Keys expansion portion of the project is estimated to be $182,700,000. This cost would be funded as follows: non-Federal sponsor: $33,400,000, Federal and non-Federal navigation projects: $49,100,000, and the Federal Construction General program: $100,200,000.

My recommendation is subject to cost-sharing, financing, and other applicable requirements of Federal and State laws and policies, including Public Law 102-580, Section 204, the Water Resources Development Act of 1992, and in accordance with the following requirements which the non-Federal sponsor shall agree to perform, prior to project implementation, the following items of local cooperation:

a. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

b. Provide all lands, easements, and rights-of-way and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the construction, operation, maintenance, repair, replacement, or rehabilitation of the project;

c. Provide during construction any additional amounts as are necessary to make its total contribution equal to 25 percent of total project costs assigned to wetland restoration;

d. Provide during construction any additional amounts as are necessary to make its total contribution equal to 50 percent of total project costs assigned to recreation, as well as any amount by which the costs of the recreation features exceed the limit of Federal cost-share of $512,460;

e. Enter into an agreement which provides, prior to construction, 25 percent of design costs;

f. Provide during construction, any additional funds needed to cover the non-Federal share of design costs;

g. Assume responsibility for operating, maintaining, replacing, repairing, and rehabilitating (OMRR&R) the project or completed functional portions of the project without cost to the Federal Government in a manner compatible with the project's authorized purpose and in accordance with applicable Federal and State laws and specific directions prescribed by the Federal Government in the OMRR&R manual and any other subsequent amendments thereto. This provision shall not preclude the Non-Federal Sponsor from accomplishing the OMRR&R of the Project through the services of a willing agency, such as the U.S. Fish and Wildlife Service, following assumption of these obligations. However, absent any modification to the Non-Federal Sponsor's OMRR&R responsibilities through written amendment to the Project Cooperation Agreement, the Non-Federal Sponsor shall remain primarily responsible, as between the Non-Federal Sponsor and the Government, for performance of OMRR&R of the Project;

h. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor now or hereafter owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of operating, maintaining, repairing, replacing, and rehabilitating the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall operate to relieve the non-Federal sponsor of responsibility to meet the non-Federal sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

i. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors;

j. Prevent future encroachments on the project lands, easements, and rights-of-way which might interfere with proper functioning of the project;

k. Provide the non-federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the project cooperation agreement;

l. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for the operation, maintenance, repair, replacement, and rehabilitation of the project, including those necessary for relocations, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

m. Comply with all applicable Federal and State laws and regulations including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army;"

n. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

o. There are ongoing and potential future remediation activities, including Comprehensive Environmental Response Compensation and Liability Act (CERCLA) covered actions, on the property necessary for the wetland project being conducted by the Department of the Army under the Base Realignment and Closure and Formerly Used Defense Sites programs. The performance and payment for these remediation activities will not be the responsibility of the Civil Works program of the U.S. Army Corps of Engineers or the non-Federal sponsor, except to the extent the pertinent Project construction activities principally accomplish design objectives in direct performance of the Project's ecosystem restoration or recreation functions, and only incidentally result in the accomplishment of the remediation objectives of other components of the Federal Government. All such other activities that are not conducted principally to accomplish ecosystem restoration functions, including funding, will be the responsibility of other parts of the Federal Government, as required by the applicable law.

p. As between the Government and the Non-Federal Sponsor, the Government shall be considered the operator, for the purposes of CERCLA liability, of those parcels comprising the

Project on which there are ongoing or potential future remediation activities conducted by the Department of the Army under the Base Realignment and Closure and Formerly Used Defense Sites programs, until such time as the Non-Federal Sponsor is obligated to assume OMRR&R responsibilities over the Project or a functional portion thereof; following such assumption of responsibilities, as between the Government and the Non-Federal Sponsor, the Non-Federal Sponsor shall be considered the operator of the Project or a functional portion of the Project for purposes of CERCLA liability. For all parcels comprising the Project on which there are no ongoing or potential future remediation activities conducted by the Department of the Army, as between the Government and the Non-Federal Sponsor, the Non-Federal Sponsor shall be considered the operator of the Project or a functional portion of the Project for purposes of CERCLA liability. The non-Federal sponsor and the Government shall consult with each other to assure that responsible parties bear any necessary cleanup and response costs as defined in CERCLA related to material imported for purposes of wetland restoration. To the maximum extent practicable, the Non-Federal Sponsor shall operate, maintain, repair, replace, and rehabilitate the Project or a functional portion of the Project in a manner that will not cause liability to arise under CERCLA;

q. Perform, or cause to be performed, for all parcels comprising the project on which there are no ongoing or potential future remediation activities conducted by the Department of the Army, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Government determines to be necessary for the construction, operation, maintenance, repair, replacement, or rehabilitation of the project; except that, for lands that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigation unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

r. For all parcels comprising the project on which there are no ongoing or potential future remediation activities conducted by the Department of the Army, assume complete financial responsibility, as between the Government and the non-Federal sponsor, for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, maintenance, repair, replacement, or rehabilitation of the project;

s. Not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized;

t. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

8 April 03
Date

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District Engineer

APPENDICES

Final General Reevaluation Report

Bel Marin Keys Unit V Expansion
of the
Hamilton Wetlands Restoration Project

Technical Appendices

Appendix A

Post Authorization Changes in Total Project First Cost

APPENDIX A

POST AUTHORIZATION CHANGES IN TOTAL PROJECT FIRST COSTS SUMMARY

Background: The Hamilton Wetland Restoration Project (HWRP)/Bel Marin Keys Unit V (BMK V) Project is a unique effort that combines multiple Federal authorities to implement a wetlands restoration project that beneficially reuses dredged material from Federal and non-Federal navigation projects. This results in unusual funding circumstances that are explained in detail in Appendix A and are briefly outlined in this summary.

The total project implementation costs for the Combined HWRP/BMKV Project will be funded through the HWRP/BMK V Project, the Oakland Deepening Project, and the other navigation projects using the project site. The Oakland Deepening Project authorization and Project Cooperation Agreement (PCA) require the Oakland Project to contribute 100% of the implementation costs associated with placing that project's estimated 2.5 mcy of Oakland material at the HWRP.

Under the Long Term Management Strategy (LTMS), many navigation projects will be precluded from disposing of dredged material in-Bay and must instead dispose at either the San Francisco Deep Ocean Disposal Site (SFDODS) or in upland sites. LTMS implementation will increase the dredged material transportation costs of a navigation project if the disposal site designated in accordance with the LTMS Implementation Plan is farther from the navigation channel than the disposal site used prior to LTMS implementation. Conversely, LTMS implementation will decrease transportation costs if the disposal site designated in accordance with the LTMS Implementation Plan is closer to the navigation channel than the pre-LTMS disposal site.

Incremental Costs: The HWRP Chief's Report and PCA authorize the HWRP to pay for the "incremental costs" of project implementation, defined as the difference between disposal costs at Hamilton versus the costs of disposal at the least-cost environmentally acceptable alternative. For all navigation projects, the least-cost environmentally acceptable alternative will be either disposal in-Bay, if permitted by the LTMS Implementation Plan, or at SFDODS.

Article I.B. of the HWRP PCA acknowledges that other projects, including but not limited to the Oakland Deepening Project, will directly fund a portion of the HWRP costs of implementation. This article further provides that these contributed funds will be excluded from the HWRP total project costs (in order to ensure, in part, that the Sponsor did not have to contribute a share of implementation costs that were actually being underwritten by an independent source).

The HWRP is required to fund not only the costs of offload, placement and reuse of dredged material delivered to the site by these navigation projects, but also any excess

costs of transporting that material to Hamilton, over and above the costs to deliver to the least-cost environmentally acceptable alternative site. For those Federal navigation projects that will incur greater cost to transport material to Hamilton than to their LTMS-designated in-Bay site, the HWRP will fund those "excess transportation costs" as an authorized component of the Project's "incremental cost." For those non-Federal navigation projects that will incur greater cost to transport material to Hamilton than to their LTMS-designated in-Bay site, the HWRP may – but is not obligated to – pay some or all of these "excess transportation costs" (the GRR project cost analysis assumes that full excess transportation costs will be paid to non-Federal projects, in order to provide maximum incentive to deliver dredged material to the HWRP).

Navigation projects that deliver dredged material to the HWRP, in lieu of disposing at SFDODS as their LTMS-designated site, will incur a decrease in transportation costs. This is because, for every navigation project within the Bay, the cost of transporting dredged material to Hamilton is less than the cost to transport and dispose at SFDODS. These Federal and non-Federal projects will transfer to the HWRP a "transportation cost differential" equal to the transportation cost savings realized by the shorter trip to the HWRP. The "Funding of HWRP Incremental Costs" section of the full Appendix A describes how these costs will be transferred from other navigation projects to the HWRP.

HWRP Cost Adjustments: The HWRP was authorized in WRDA 1999 at a cost of $55.2 MIL. These costs were revised to reflect the cost increases associated with inflation, utility relocations, offloader standby costs, and excess transportation costs, as explained in Section 6.9.2 of the main text of Appendix A. The adjustments to the HWRP costs define the total HWRP implementation costs if the HWRP were to be constructed without the BMK V expansion. These costs are shown below:

Adjusted Total HWRP Implementation Costs

($MIL)

	Total Project Cost (1998$)	Adjusted Total Project Implementation Cost (2002$)
Lands, Easements, Rights of Way	0.3	0.4
Relocations	2.1	12.6
PED & Construction Mgmnt	4.1	16.3
Site Prep	19.3	19.6
Navigation Ports & Harbors	27.8	n/a
Offload/Placement	n/a	54.4
Excess Transportation Costs	n/a	12.9
Adaptive Management	1.5	2.8
Total	55.2	119.0

Combined HWRP/BMK V Costs: The adjusted the HWRP costs were added to the BMK costs to compute the total combined project implementation costs, displayed in the following table.

Total Project Implementation Costs
($MIL)
(2002$)

	HWRP	BMK V	Combined Project
LERs	0.4	19.4	19.8
Relocations	12.6	0.3	12.9
PED & Construct. Mgmt	16.3	22.4	38.7
Site Prep	19.6	40.4	60.0
Offload/Placement	54.4	79.6	134.0
Excess Transport. Cost	12.9	16.7	29.6
Recreation	0.0	0.2	0.2
Adaptive Management	2.8	3.7	6.5
Total	119.0	182.7	301.7
Reference to Figure A-1	(B)	(C)	(A)

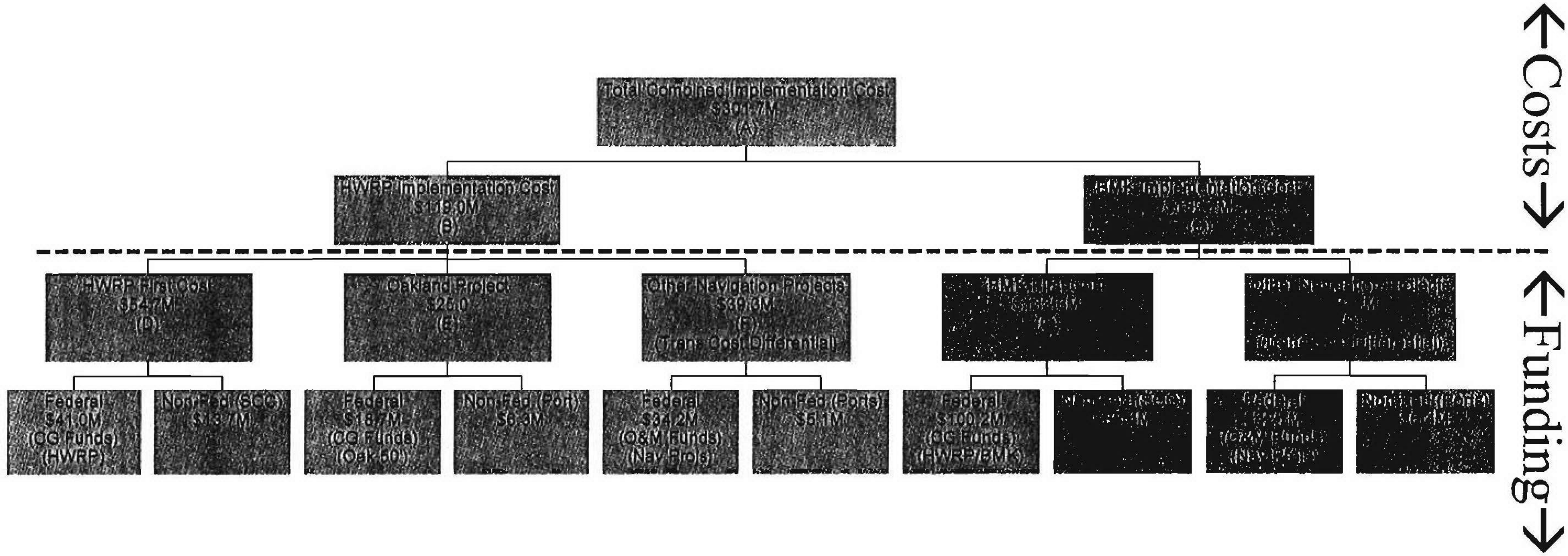
The total project implementation cost for the combined project forms the basis for the total first project cost, which defines the cost-sharing contributions for the Corps and the local Sponsor. The Oakland Deepening Project's contribution and the "transportation cost differential" funding provided by other navigation projects must be subtracted from the total project implementation cost to determine the total project first cost. This is necessary to avoid redundant Federal appropriations covering identical components of both the HWRP and other Federal navigation projects, and to account for contributions of "transportation cost differential" funding by non-Federal navigation projects. As shown in the table below, the total first project cost for the combined HWRP/BMK V project is $188.3 MIL, and this figure will form the basis of cost-sharing. The total project first cost is equivalent to the project's "construction general" funding cost.

Total Project First Costs
($MIL)

Total Project Implementation Cost for Combined Project	Oakland Project's Contribution	Other Navigation Project Contributions	Total Project First Cost
$301.7 million	$25.0 million	$88.4 million	$188.3 million
Figure A-1 reference (A)	Figure A-1 reference (E)	Figure A-1 reference (F+H)	Figure A-1 reference (D+G)

These costs are illustrated in Figure A-1, which shows cost figures that correspond to the tables above.

Figure A-1
HWRP/BMK Project Costs



1/Costs for Other Navigation Projects based on present projections of dredged material deliveries to the HWRP.

APPENDIX A

POST AUTHORIZATION CHANGES IN TOTAL PROJECT FIRST COSTS

This appendix provides a detailed description of the changes in total project first costs, as summarized in Section 6.9 of Chapter 6 of the main text of the General Reevaluation Report. The section numbers of this appendix are the same as those of the corresponding sections in Chapter 6.

6.9.1 Long Term Management Strategy (LTMS) and Hamilton Wetland Restoration Project (HWRP) Costs

The relationship between LTMS costs and HWRP project costs is described below.

The members of the Long Term Management Strategy (LTMS) Executive Committee signed and approved the Final LTMS Management Plan in January 2002. The members of the Executive Committee include the Corps of Engineers, the Environmental Protection Agency, the San Francisco Bay Regional Water Quality Control Board, the San Francisco Bay Conservation and Development Commission, and the State Water Resources Control Board. The Final LTMS Management Plan reduces the allowable in-bay disposal volumes of dredged material by more than 50% compared to pre-LTMS volumes. Implementation of LTMS will require that much of the dredged material that has historically been placed in the bay be placed in upland sites or in the ocean. Other than the small volume that the smaller navigation projects will continue to be allowed to dispose of in-Bay, dredged material disposal will be evenly allocated between upland and ocean sites, and full allocation to upland or ocean disposal will be phased in over 12 years.

Presently, the LTMS Implementation Plan is not mandating any upland disposal, but has designated ocean disposal for some navigation projects and will be designating disposal at the San Francisco Deep Ocean Disposal Site (SFDODS) for other projects as the implementation transition period proceeds. Thus, implementation of LTMS will have no immediate impact on the disposal costs of those projects presently disposing at the ocean site. However, since in-bay disposal is the least costly alternative, implementation of LTMS will increase the cost of navigation improvements and associated maintenance for the projects currently using in-bay disposal sites that will instead place dredged material upland or at the ocean site under the LTMS Implementation Plan. The magnitude of the post-LTMS cost increase will vary from project to project, and will depend on the location of the present disposal site and whether the new disposal destination is upland or in the ocean. Upland sites must be developed to accommodate the new disposal strategy, and the cost to develop these sites for Federal projects will be funded, at least in part, by the Corps' navigation construction and O&M programs.

The tables below illustrate the cost increases associated with LTMS implementation for two hypothetical navigation projects: First, consider a project with a Pre-LTMS in-bay disposal site. If the project shifts from in-bay to ocean disposal following LTMS implementation, the transportation costs will increase for the project. The LTMS cost increase (or LTMS incremental cost) would be $6/cubic yard (cy). There will always be a cost increase to shift from in-bay to ocean disposal because the distance from every navigation project in the Bay to the ocean disposal site is farther than the distance to the corresponding in-bay site.

COST INCREASES ASSOCIATED WITH LTMS IMPLEMENTATION
SHIFT FROM IN-BAY TO OCEAN DISPOSAL

	Pre-LTMS Cost ($/cy)	Post-LTMS Cost ($/cy)	LTMS Incremental Cost ($/cy)
Item Description	**In-Bay Disposal**	**Ocean Disposal**	**Ocean Disposal**
Site preparation & offload/placement	N/A	N/A	N/A
Dredge & transport to disposal site	$7	$13	$6
Total	$7	$13	$6

If the project shifts from in-bay to upland disposal, two new expense items would be incurred (site preparation and offload/placement). These costs would add $9/cy to the overall disposal cost. The cost associated with dredging and transportation could increase or decrease depending on the relative locations of the in-bay site, the upland site, and the navigation project site. The hypothetical scenario in the table below assumes that the pre-LTMS in-bay site would be slightly closer to the navigation project than the Hamilton site, resulting in a moderate cost increase to the navigation project's transportation component. If the project shifts from in-bay to upland disposal, the hypothetical overall LTMS cost increase would be $10/cy.

COST INCREASES ASSOCIATED WITH LTMS IMPLEMENTATION
SHIFT FROM IN-BAY TO UPLAND DISPOSAL

	Pre-LTMS Cost ($/cy)	Post-LTMS Cost ($/cy)	LTMS Incremental Cost ($/cy)
Item Description	**In-Bay Disposal**	**Upland Disposal**	**Upland Disposal**
Site preparation & offload/placement	$0	$9	$9
Dredge & transport to disposal site	$7	$8	$1
Total	$7	$17	$10

Authorized HWRP Incremental Costs

The HWRP was authorized in WRDA 1999 at a cost of $55.2 MIL. Project features included preconstruction engineering and design (PED), site preparation, and material offload and placement costs for 10.6 million cubic yards (mcy) of material to be placed at the HWRP site.

Authorized HWRP Costs

($ MIL)

1998 Hamilton Project Cost (excluding Bel Marin Keys expansion)	
	HWRP WRDA '99 Cost (1998 MIL$)
Lands, Easements and Rights of Way	0.3
Relocations	2.1
PED & Construction Mgmnt	4.1
Site Prep	19.3
Navigation Ports & Harbors	27.8
Adaptive Management	1.5
Total	55.2

1/ The Project Cooperation Agreement (PCA) defines the 902 Limit as $72.4 MIL.

As described above, implementation of LTMS will have no immediate impact on disposal costs for those navigation projects presently disposing at the ocean site. However, those navigation projects currently disposing at in-bay sites for which disposal designations will change under LTMS implementation will have to either pay higher transportation costs to take material to the ocean or additional costs to place material in upland sites. The HWRP was authorized to fund the "incremental cost of transportation and disposal of dredged material." This Hamilton incremental cost is defined, in paragraph 6 of the Chief's Report, as the value by which the costs of transportation and disposal of dredged material to the HWRP exceed the costs of transportation and disposal at the least-cost environmentally acceptable disposal alternative. This authority effectively allows the HWRP to share the LTMS incremental cost with the navigation projects.

Because the LTMS implementation plan has designated ocean disposal for some navigation projects, but has not mandated use of any upland disposal site, the least-cost environmentally acceptable disposal alternative for the navigation projects delivering material to the HWRP will either be at an in-bay site or ocean disposal. Costs associated with dredging and transporting material to the HWRP site are to be funded by the individual navigation projects placing material at HWRP, *to the extent of those projects' estimated costs of dredging, transportation, and disposal at the least-cost environmentally acceptable alternative disposal site determined in accordance with the*

LTMS implementation plan. All costs of transportation to and placement and reuse at the HWRP that exceed the transportation and disposal costs of this least-cost environmentally acceptable alternative disposal method, are to be allocated to Hamilton total project costs. These excess costs are defined as HWRP **incremental costs**.

The incremental cost allows the HWRP to share the costs of beneficial reuse of dredge material with Federal and non-Federal navigation dredging projects. With the HWRP contribution to the LTMS implementation costs, San Francisco Bay dredging projects acquire the intangible benefit of "green" reuse of dredged material at an ecosystem restoration site vice in-water disposal as well as predictability in the permitting process and in the degree of public acceptance of dredging activities, without having to pay the cost premium that would otherwise be associated with such beneficial reuse.

Illustration of the basic application of the Hamilton "incremental cost" concept is relatively straightforward. A typical navigation project will contract directly for dredging and transporting the material to Hamilton. The HWRP will take the material from there: offloading and placing the material onshore for construction of the restoration project. The HWRP will directly contract for, and fund the costs of, those offload, placement, and ecosystem development costs.

There will be navigation projects for which the costs to dredge and transport to Hamilton will be greater than the costs of dredging and disposing at the alternate in-Bay site designated in accordance with LTMS implementation. For the Federal projects that fall into this category, Article II.F. of the HWRP Project Cooperation Agreement (PCA) specifies that the funding responsibility for this cost difference will be allocated to the HWRP, as a component of Hamilton's "incremental cost." The HWRP will thus transfer the appropriate funding to cover this excess transportation cost to that Federal navigation project to offset a portion of its dredging and transportation contract. For non-Federal navigation projects where the costs to dredge and transport to Hamilton are greater than the costs to dredge and dispose at the alternative in-Bay site designated in accordance with LTMS implementation, the PCA provides that the HWRP has the discretion to contribute toward this transportation cost difference (as well as all other components of Hamilton incremental costs). If the HWRP needs the volume of material represented by that non-Federal project, the HWRP may elect to pay some or all of the incremental cost in order to provide an incentive to deliver that material to Hamilton.

A number of navigation projects presently dispose of dredged material at SFDODS as their "least-costly environmentally acceptable alternative." These projects presently include the following projects shown below. It will be less expensive for these projects to dredge and transport material to Hamilton, than to dredge and transport offshore to SFDODS for ocean disposal.

Federal	Non-Federal
Oakland Deepening	Port of Oakland berths maintenance
Oakland Harbor maintenance	Port of Richmond berths maintenance
Richmond Harbor maintenance	

More navigation projects will be shifted from in-bay to ocean disposal as LTMS implementation is gradually phased in. Those projects must assume the additional costs associated with LTMS implementation, regardless of whether the HWRP is an available disposal option or not. For example, the Oakland Harbor maintenance project and the Richmond Harbor maintenance project must now pay the costs of SFDODS disposal as their least-cost environmentally acceptable disposal option. The fact that the HWRP presents a beneficial reuse opportunity at no extra premium provides those projects the incentive to choose to place material at Hamilton in lieu of offshore disposal. The costs of SFDODS disposal, for the Oakland and Richmond maintenance projects, constitute a minimum fixed cost, from this point forward.

The incremental costs associated with two hypothetical projects are illustrated in Figures 6-1 and 6-2. In both cases, the HWRP costs for PED, site preparation, and material offloading and placement is $8.63/cy.

Figure 6-1 illustrates a navigation project that has a least-cost environmentally acceptable alternative disposal site at SFDODS. In this case, the project would pay $14/cy to dredge and haul material to its LTMS-designated ocean disposal site. When this project dredges and hauls material to HWRP instead of SFDODS, it will continue to pay a cumulative sum of $14/cy for dredged material disposal, and the HWRP will fund the remaining disposal costs associated with the HWRP, or $2.63/cy, which are the incremental costs. In this case, the incremental costs do not include any costs associated with transporting the material to the HWRP site because it is cheaper to haul the material to the HWRP site than to SFDODS. The navigation project will pay (to its dredging contractor) $8/cy to dredge and haul the material to the HWRP site plus pay (to the Hamilton Project) an additional $6/cy for HWRP site preparation, offloading, and placement costs. Thus, the navigation project is paying no more and no less than the cost of its least-cost environmentally acceptable alternative disposal method, and the HWRP pays the incremental cost associated with beneficial reuse of dredged material at the HWRP site.

Figure 6-2 illustrates a navigation project that has a least-cost environmentally acceptable alternative disposal site within San Francisco Bay. In this case, the project would pay $7.21/cy to dredge and haul material to the LTMS-designated in-bay site. When this project dredges and hauls material to HWRP instead of the in-bay site, it will fund its expected cost of $7.21/cy for dredged material disposal, and the HWRP will fund the remaining disposal costs associated with the HWRP, or $9.26/cy, which are the incremental costs associated with the HWRP. In this case, the incremental costs include the additional costs associated with transporting the material to the HWRP ($0.63/cy) as well as the site preparation, offload and placement costs. Again, the navigation project is paying no more and no less than the cost of its least-cost environmentally acceptable alternative disposal method, and the HWRP pays the incremental cost associated with beneficial reuse of dredged material at the HWRP site.

FIGURE 6-1
Navigation Project with Alternate Disposal Method that Utilizes SFDODS
(Value figures are illustrative, based on the Oakland Maintenance Project)

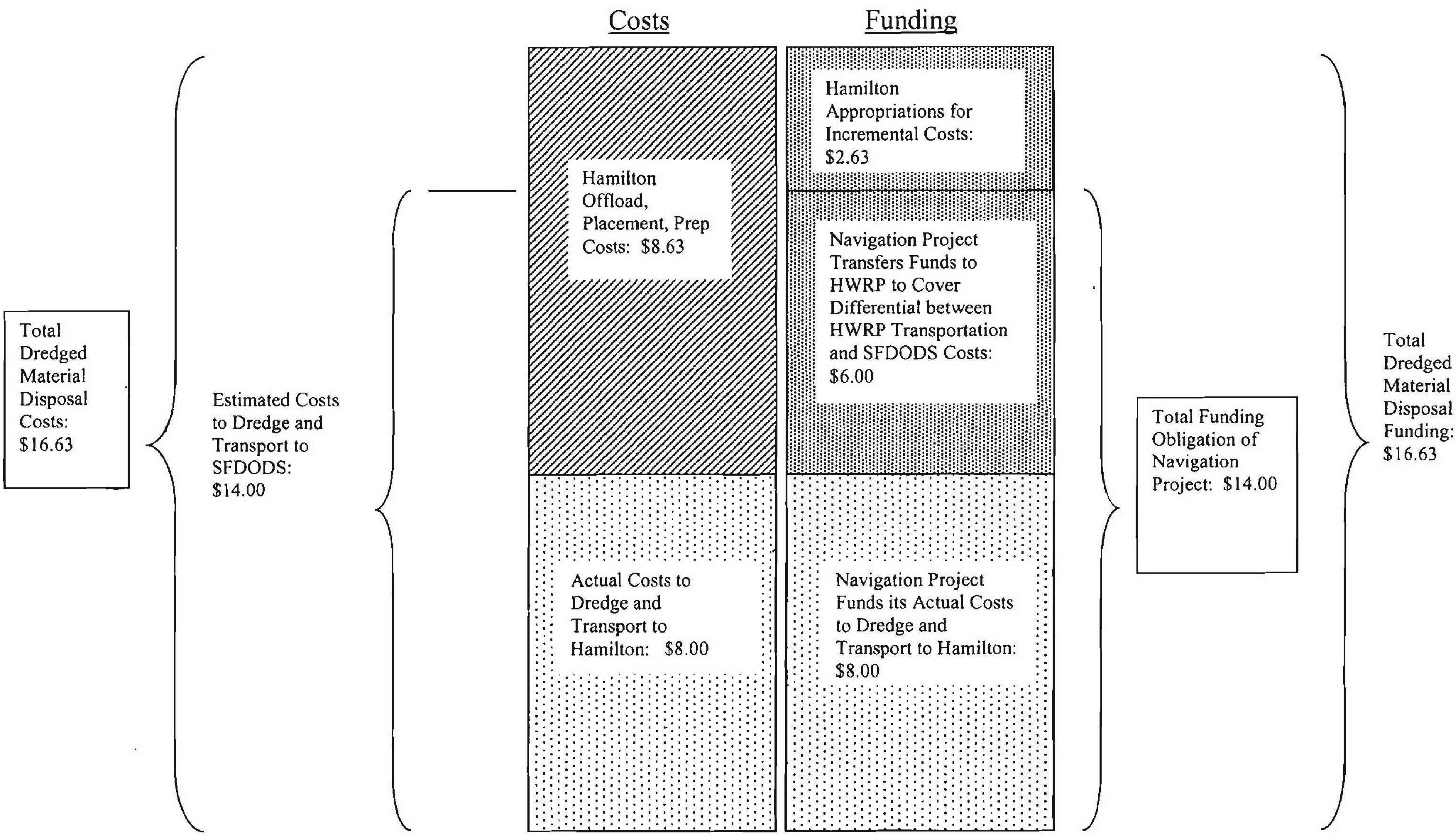


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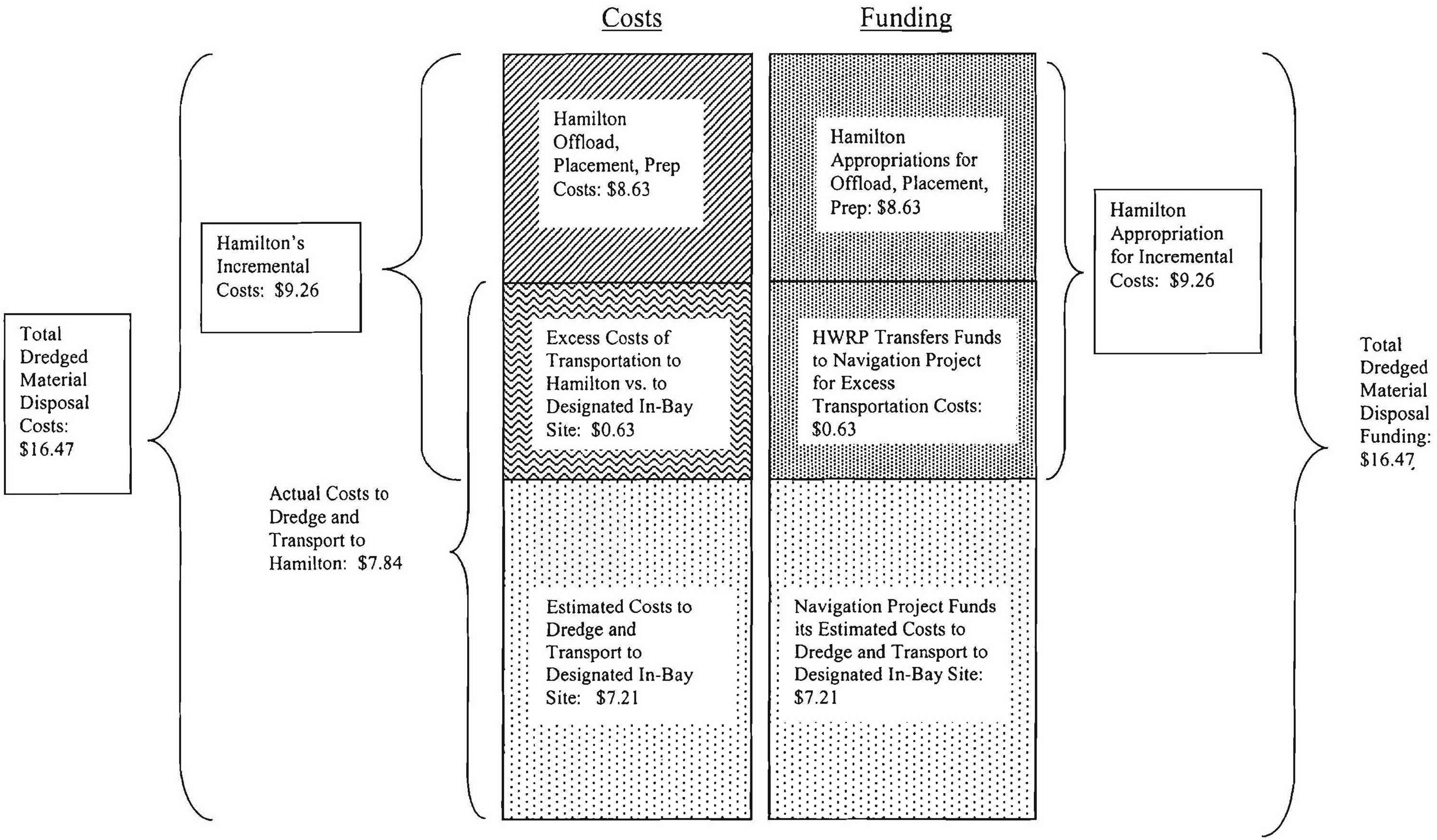
FIGURE 6-2
Navigation Project with Alternate Disposal Method that Utilizes In-Bay Site
(Value figures are illustrative, based on the Pinole Shoals Maintenance Project)



Funding of HWRP Incremental Costs

Differential Costs Associated with the Shift from Ocean to HWRP Disposal: It is appropriate and necessary that those navigation projects with ocean disposal sites would transfer funding to the HWRP that corresponds to the value of the savings they would otherwise see in reduced dredged material transportation costs, where that cost differential is made possible by the existence of the HWRP. In other words, this savings to the navigation dredging community, made possible by the HWRP's proximate location and the HWRP's contribution of incremental costs, should more properly accrue to the Hamilton Project itself, than to the individual navigation projects.

Each navigation project designated under LTMS for ocean disposal must therefore pay (with each annual maintenance episode constituting a separate project) to the HWRP the cost differential between (1) that project's estimated costs to dredge, transport to, and dispose of material at its LTMS-designated disposal alternative, and (2) that project's actual costs to dredge and transport material to Hamilton, for subsequent offload at HWRP expense. The requirement to pay this cost differential to the HWRP will not modify the total funding obligations of the navigation projects. Each navigation project will pay the same amount as they would be paying for dredging and SFDODS disposal, but will merely be paying a portion to their dredging and transportation contractor and the balance to the HWRP.

There is ample support for application of the concept of requiring the navigation projects that would otherwise dispose of dredged material at SFDODS to contribute their transportation and disposal cost savings to the HWRP.

a. Paragraph 6 of the HWRP Chief's Report expressly acknowledges that "a portion of [the transportation, offload, placement, and site preparation] costs will actually be funded by other navigation projects." Paragraph 6 specifically discusses the unique cost-sharing relationship between the HWRP and the Oakland Deepening project, but also notes that there are a number of projects intended to fund a portion of HWRP costs other than the Oakland new-work project. The fact that San Francisco Bay navigation projects will generally be contributing funds to offset a portion of HWRP implementation costs is thus specifically acknowledged in the Chief's Report.

b. The provisions of the HWRP PCA also accommodate transfer of these contributions of cost savings from navigation projects to the HWRP. Article I.B. acknowledges that other projects, including but not limited to the Oakland Deepening Project, will directly fund a portion of the HWRP costs of implementation. This article further provides that these contributed funds will be excluded from the HWRP total project costs (in order to ensure, in part, that the Sponsor did not have to contribute a share of implementation costs that were actually being underwritten by an independent source). Additionally, Article II.F. mandates that "no costs shall be allocated to the Project which are to be directly funded" by another navigation project, including but not limited to the Oakland Deepening Project.

c. Finally, as discussed above, there is express authorization for Hamilton to fund and execute the activities associated with the HWRP "incremental cost," but no authorization to exceed the scope of this incremental cost's funding authority and further share in, or offset, the dredged material disposal costs of navigation projects within San Francisco Bay.

It is important to note that this transfer of funds, representing a navigation project's cost savings arising from the availability of the HWRP, does not constitute a "tipping fee." A tipping fee would involve an allocation of the Hamilton Project's costs among the navigation projects placing dredged material at the site, presumably in relation to the volume of material contributed as a proportion of total HWRP capacity. The transfer of funds reflecting the differential between transportation costs associated with SFDODS versus Hamilton use is not calculated based on HWRP implementation costs, however. In fact, Hamilton's costs are completely irrelevant to the computation of the amount of funds to be transferred. The value of funds to be transferred depends solely on the navigation project's costs – or more particularly the savings that would otherwise be seen in those costs, resulting from the opportunity to use the Federal restoration project at Hamilton.

The value of the transportation cost differential to be transferred would be computed, for Federal projects, as follows: the actual cost of the Federal contract to dredge the material and transport it to Hamilton for subsequent offloading would be subtracted from the MCACES estimate for dredging that same volume of material, and transporting it to and disposing it at the least-cost environmentally acceptable disposal option, as designated under the LTMS implementation plan. Presently, the only San Francisco Bay navigation projects that would otherwise be expected to experience such a cost differential and would thus be required to transfer these funds, are the projects disposing of dredged material at SFDODS.

The value of the transportation cost differential to be transferred. Presently, the Port of Oakland and Port of Richmond berths maintenance projects are designated for SFDODS disposal, and would therefore be required to pay to the HWRP the cost differential between Hamilton transportation costs and SFDODS transportation/disposal costs. The value of the funds transfer would be established in an MOA in which the other terms and parameters of the dredged material placement authorization would also be reflected. The value of funds to be transferred would be computed, for these non-Federal projects, as follows: the Federal MCACES estimate of the reasonable cost of the proponent's contract to dredge the material and transport it to Hamilton for subsequent offloading (taking into consideration, but not dictated by, the actual cost of that non-Federal contract) would be subtracted from the MCACES estimate for dredging that same volume of material, and transporting it to and disposing it at the least-cost environmentally acceptable disposal option, as designated under the LTMS implementation plan.

Acceptance by the HWRP of these "differential cost" payments does not constitute an impermissible augmentation of funds in violation of Federal fiscal law. The Chief's Report, incorporated by express reference into the WRDA 1999 authorization of the Project, indicates that "a portion of these [HWRP implementation] costs will actually be

funded by other navigation projects." This statement expressly provides statutory authority for the HWRP to utilize funding from sources other than the funds directly appropriated to the Hamilton Project. The Chief's Report specifically cites the Oakland Deepening Project as one such likely source, but notes that other navigation projects could also serve as such a source. As these Oakland Deepening Project funds include both Federally-appropriated Oakland Project funds as well as the Sponsor's cost-share contributions, the Hamilton Project authorization implicitly authorizes augmentation of HWRP funds with both Federal funds originally appropriated to another specific purpose, as well as with non-Federal funds.

It was clearly the intent of Congress to authorize direct augmentation of Hamilton Project funds by both Federal and non-Federal funds, rather than to treat these funds as miscellaneous receipts for deposit in the Treasury general fund. The authorization to accept these augmenting funds from "other navigation projects" that include both Federal and non-Federal projects is merely implicit, however.

To provide predictability and clear direction, the implicit features of the HWRP funding sources should be made explicit in the statutory re-authorization language. This language should expressly authorize that "the monies received from the Oakland Harbor Navigation Improvement (-50-Foot) Project as its proportionate share of the implementation costs of the Hamilton Wetland Restoration Project, or received from other Federal or non-Federal navigation projects within San Francisco Bay and representing the amount by which the dredging and transportation costs of such a navigation project incurred in delivering dredged material to the Hamilton site for subsequent offload and placement exceed the costs such a navigation project would have incurred in disposing of that volume of material under the least-cost environmentally acceptable disposal alternative designated in accordance with the Long Term Management Strategy Implementation Plan for Placement of Dredged Material in the San Francisco Bay Region, shall be available to the Secretary, and shall be used by the Secretary, for the implementation of the Hamilton Wetland Restoration Project, and shall be excluded from the computation of the maximum cost of the Project, as that term is used in 33 USC § 2280." Such express language would be fully consistent with Articles I.B. and II.F. of the Hamilton PCA.

<u>Excess Transportation Costs Associated with the Shift from In-Bay to HWRP Disposal</u>: As discussed previously, there are a number of Federal navigation projects for which the costs of dredging and transporting to Hamilton exceed the costs associated with dredging, transporting to, and placing at the least-cost environmentally acceptable disposal option.

For all Federal projects that presently continue to be authorized to use in-Bay disposal sites, the costs of transporting dredged material to Hamilton will be greater than the costs of the alternative in-Bay site. The HWRP will pay these excess transportation costs to the navigation project, through an inter-project administrative transfer of funds. This component of costs forms a portion of the Hamilton incremental costs, which are to be allocated to HWRP total project costs, as provided in the HWRP PCA.

The value of the excess transportation costs to be paid by the HWRP would be computed, for Federal projects, as follows: the actual cost of the Federal contract to dredge the material and transport it to Hamilton for subsequent offloading, less the MCACES estimate for dredging that same volume of material, and transporting it to and disposing it at the in-Bay site.

There are also non-Federal navigation projects to which excess transportation costs will be paid. Article II.F. of the HWRP PCA provides the Project the discretion to either pay incremental costs to non-Federal projects or to decline to do so. These incremental costs would include, for non-Federal navigation projects that remain authorized to dispose of dredged material in-Bay and as long as the HWRP elects to pay them to attract the material from that non-Federal project, the amount of the HWRP offload and placement costs as well as a sum that is no greater than the amount by which the navigation project's costs to transport to Hamilton exceed the costs to transport to the LTMS-designated in-Bay site.

The value of funds to be transferred to the non-Federal navigation projects as excess transportation costs would be computed as follows: the Federal MCACES estimate of the reasonable cost of the proponent's contract to dredge the material and transport it to Hamilton for subsequent offloading (taking into consideration, but not dictated by, the actual cost of that non-Federal contract), less the MCACES estimate for dredging that same volume of material, and transporting it to and disposing it at the in-Bay site.

The table below illustrates the application of the HWRP incremental cost and differential cost concepts. Two representative categories of projects were chosen for purposes of comparison: a major harbor maintenance project (Oakland) required under LTMS implementation to dispose of its dredged material at SFDODS; and a smaller navigation maintenance project where the costs to dredge and transport to Hamilton are greater than the costs of dredging, transporting to, and disposal at the LTMS-designated in-Bay disposal site (Pinole Shoals). Note that, theoretically, there is a third category of projects: projects where the costs to dredge and transport to Hamilton are less than the costs of dredging, transportation to, and disposal at the LTMS-designated in-Bay disposal site. However, as a practical matter, there are no navigation projects in San Francisco Bay authorized for in-Bay disposal for which the unit costs of dredging and transporting to Hamilton are less than the costs of dredging, transporting to, and disposing at the LTMS-designated alternative. If such projects existed, incremental and differential costs would be addressed in a manner similar to those projects designated for disposal at SFDODS.

The following table provides a tabular illustration of these concepts. Cost category A, in the table below, illustrates the total costs incurred for a cubic yard of dredged material from the point of dredging all the way through offload and placement at Hamilton. Cost category B illustrates the cost to the navigation project of dredging, transporting to, and disposing at the site designated under the LTMS Implementation Plan. Cost category C illustrates the incremental costs as defined in the PCA: the total costs of dredging all the way through offload, placement, and site preparation at Hamilton, minus the total costs to dredge, transport to, and dispose of an equivalent volume of material at the site designated under the LTMS Implementation Plan. Cost category D illustrates the

navigation project's actual costs to dredge and transport material to Hamilton for subsequent offload and placement. Cost category E is the excess cost incurred by the navigation project, if any, to dredge and transport to Hamilton. Any excess cost in category E will be paid by the HWRP to the navigation project, and will be accounted for as part of Hamilton's incremental cost. Finally, cost category F is the differential, if any, between the navigation project's actual costs to dredge and transport to Hamilton, and the authorized extent of the HWRP's incremental costs. This is the difference between the navigation project's costs to dredge/transport/dispose at the LTMS-designated site, and that project's actual costs to dredge and transport to Hamilton. This transportation cost differential will be paid by the navigation project to the HWRP.

Those navigation projects with a post-LTMS designated disposal site of SFDODS will pay a significant differential per cubic yard to the HWRP. Those navigation projects for which the LTMS-designated disposal site is in-Bay will be compensated by the HWRP a moderate amount, offsetting a portion of the navigation project's dredging and transportation costs. Computation of this moderate payment will be primarily dependent upon the difference in transportation costs from the navigation project to Hamilton versus the transportation costs from the navigation project to the LTMS-designated in-Bay site.

Application of Hamilton Incremental Cost and Differential Cost Concepts
(Value figures are illustrative)

	Navigation Projects Designated under LTMS for Disposal at:	
	SFDODS	In-Bay
A. Total costs of navigation project to dredge/ transport/offload/place at Hamilton (in ($/cy))	$16.63	$16.47
B. Costs of navigation project's alternative disposal method	$14	$7.21
C. HWRP's incremental costs (Total costs minus least-cost alternative) *[A minus B]*	$2.63	$9.26
D. Navigation project's actual costs to dredge/ transport to Hamilton	$8	$7.84
E. Amount by which HWRP costs exceed the costs of the alternate disposal method (positive values only; paid by the HWRP to the navigation project as part of the HWRP "incremental cost") *[D minus B]*	$0	$0.63
F. Transportation cost differential between the Hamilton-subsidized costs and the navigation project's actual costs (paid by the navigation project to the HWRP) *[A minus C minus D plus E)*	$6	$0

6.9.2 Post-WRDA HWRP Implementation Cost Adjustments

In anticipation of the re-authorization of the HWRP to add the BMK V parcel, the design team has revised the original WRDA 1999 project cost for HWRP to reflect the cost increases associated with inflation, utility relocations, offloader standby costs, and excess transportation costs.

PED and Site Preparation

PED (including construction management) costs were adjusted from 1998$ to 2002$ as shown below. These costs were adjusted to account for the lengthy construction period, required overtime and changed labor rates. Costs were added to PED for value engineering studies. Site preparation costs were adjusted to reflect current conditions and adjusted for inflation.

Table 6-4 PED 1/ Costs ($million)

1998$	**Inflated to 2002$**
4.1	16.3

1/ includes construction management costs

Site Preparation Costs ($ MIL)

	1998$	**Inflated to 2002 $**
Site Prep	19.3	19.6
Adaptive Management	1.5	2.8

Utility Relocation Costs

The HWRP feasibility study assumed that the existing Novato Sanitary District outfall could be protected during construction by slip-lining the pipeline and leaving it in place during construction. However, PED investigations have indicated that a much longer portion of the pipeline would require slip-lining, thus increasing the costs beyond the point of being cost-effective. It was concluded that the most cost-effective method to protect the existing outfall pipeline would be to replace it in-kind with an adjacent plastic (HDPE) pipeline. The utility relocation cost increased as a result of this analysis.

Utility Relocation Costs ($ MIL)

1998$	**Increased Utility Costs**	**Adjusted Cost 2002$**
2.1	+10.5	12.6

Offload/Placement Costs

The WRDA 1999 HWRP costs included a line item for "Navigation Ports and Harbors" that accounted for offload and placement costs and that was based on an average cost of \$2.62/cy. For clarity, this line item has been broken out into offload/placement costs and excess transportation costs.

The offload/placement costs were computed for the combined HWRP/BMK V project and then the HWRP and BMK V proportionate shares of these costs were calculated based on the volume of material that would be required for the HWRP and for the BMK V addition. Table A-1 the end of Appendix A presents the data that were used to compute the offloader mobilization/demobilization and operational costs. Columns "K" and "L" of Table A-1 display the unit costs associated with these activities. These unit costs were multiplied by the volume of material to be delivered by each respective navigation project to the combined HWRP/BMK V project to compute the total offloader operating and mobilization/demobilization cost, shown in column "O". This cost was then added to the following offloader construction and standby costs to compute the total offload cost for the combined project.

Total Offload Costs for the Combined HWRP/BMK V Project

	$MIL
offload operating and mob/demob (Table A-1 column "O")	$ 71.0
offloader platform/pipeline/electrification	$ 6.6
offloader equipment standby	$ 17.8
offloader labor standby	$ 21.5
Subtotal	$ 116.9
contingency	$ 13.2
Total	**$ 130.1**

Note: The Hamilton feasibility study assumed that the offloader mechanism would operate continuously throughout the construction period. However, the revised design assumes that the offloader will be in a standby mode for approximately 15 to 20% of the project construction period. Offloader equipment and operators must be paid during this standby time. These standby costs were not accounted for in the original feasibility cost estimate.

To obtain an updated estimate of the offload/placement costs attributable specifically to the HWRP, this total adjusted costs for the combined HWRP/BMK V Project was divided by the proportion of total volume capacity ascribed to the HWRP:

Offload/Placement Costs ($ MIL)

1998$	**2002 $ Adjusted Cost**
27.8	54.4

Excess Transportation Cost

As discussed previously, Federal and non-Federal navigation projects that presently dispose of dredged material at in-Bay sites would incur additional transportation costs to dredge and transport material to Hamilton instead of to their designated in-Bay sites. In each of these cases, the HWRP will fund this "excess transportation cost" of hauling the material to Hamilton. The excess transportation cost has been computed based on the volume of material expected to be delivered from each of the applicable navigation projects over the life of the HWRP. As many of the remaining individual in-bay projects shift to SFDODS disposal during implementation of LTMS, the excess transportation cost will be eliminated, and the projects will instead pay to the HWRP the cost differential as described in the section above, entitled "Funding of HWRP Incremental Costs".

The LTMS Implementation Plan requires that in-bay disposal gradually shift to ocean or upland disposal over a 12-year period. Because the LTMS navigation project-by-project schedule has not yet been developed for those projects still disposing of dredged material in-Bay, assumptions were made regarding projected LTMS implementation for the purposes of computing excess transportation costs for the HWRP: for the first 3-year period, 25% of the in-bay volume was presumed to shift shifted to ocean or upland sites: for the second 3-year period, it was presumed that 50% of the in-bay volume will be shifted to ocean or upland sites; the percentage increases to 75% and 100% for the third and fourth 3-year periods, respectively.

Because the project-by-project LTMS implementation schedule is unknown at this time, three different implementation scenarios were explored for the purposes of computing excess transportation costs and cost differentials.

LTMS Implementation Scenario 1: For this first case, it was assumed that those projects currently placing material at in-bay sites would continue to do so throughout the HWRP/BMK V construction period. None of that material would shift to ocean disposal during the HWRP implementation period.

LTMS Implementation Scenario 2: For this second case, it was assumed that those projects currently placing material at in-bay sites would shift to ocean disposal at the LTMS implementation rate: 25% for first 3-year period, 50% for second 3-year period, 75% for third 3-year period, and 100% for fourth 3-year period and beyond. The volume of in-bay material would gradually decline over the HWRP/BMK V construction period, ultimately reaching a point of 100% ocean disposal for all projects delivering material to the HWRP/BMK V combined project.

LTMS Implementation Scenario 3: The ultimate goal of LTMS is to reduce the volume of in-bay disposal to 1 million cubic yards (mcy) per year by the beginning of 2012. Very small projects will receive priority to maintain their present entitlement to in-bay disposal. Of the 1.0 mcy goal, approximately one-quarter of that volume will be reserved for these very small projects. For this third case, it was assumed that those in-bay

projects bringing material to the HWRP would account for the remaining three-quarters of in-bay disposal volume. In other words, it was assumed that, collectively, those projects would continue to dispose up to 750,000 cy of material in-bay, and that the remaining volume of dredged material derived from Bay navigation projects would be taken to SFDODS. The computation for this scenario assumed the same gradual rate of shift from in-Bay to SFDODS disposal as in Scenario 2, but overlaid this computation with an assumption that the first 750,000 cy of material would remain entitled to in-Bay disposal.

Table A-1 at the end of Appendix A computes the excess transportation costs for Scenario 1, which becomes the base case. Under this "no LTMS shift" scenario, the excess transportation costs associated with continued in-bay disposal totals $32.0 MIL (column "Q"). Table A-2 computes the shifts in volume from in-bay to ocean disposal for LTMS Implementation Scenarios 2 and 3 and the associated reduction in excess transportation costs and the increase in differential costs. Table A-2 shows the following results for the combined HWRP/BMK V project:

Summary of LTMS Implementation Scenarios
for the Combined HWRP/BMK V Project

Scenario	Vol. Shifted from In-Bay to Ocean (cy)	Reduction in Excess Transportation Costs 1/	Increase to Differential Transportation Costs 2/
1	0	$0	$0
2	7,502,000	$23,959,000	$62,898,000
3	**754,000**	**$2,407,000**	**$6,320,000**

1/ Reduction from base excess transportation cost of $32.0 MIL
2/ Increase to base differential cost of $82.1 MIL

When these cost adjustments are applied to the base case presented in Table A-2, the excess transportation costs and differential transportation costs are modified as follows:

Adjustments to Excess Transportation Costs
and Differential Transportation Costs
as a Result of LTMS Implementation Scenarios

Scenario	Comparison of the HWRP's Excess Transportation Costs ($MIL)			Comparison of Differential Transportation Costs to be Paid to the HWRP ($MIL)		
	Total	HWRP Share	BMK V Share	Total	HWRP Share	BMK V Share
1 (base case)	$32.0	$13.9	$18.0	$82.1	$36.5	$45.6
2	$8.1	$3.5	$5.0	$144.9	$64.3	$80.6
3	**$29.6**	**$12.8**	**$17.0**	**$88.4**	**$39.3**	**$49.1**

Scenario 1 was included for illustrative purposes, but was rejected for cost estimating purposes because it makes no attempt to project a schedule of LTMS implementation and to estimate the associated cost impact to the HWRP. Of the two remaining, the third scenario illustrates the greater net cost to the HWRP and thus the more conservative implementation assumption. Scenario 3 was used as the basis for computing excess transportation costs and differential transportation costs for this analysis for the combined HWRP/BMK V project. The proportionate shares of these costs for the HWRP and the BMK V expansion were computed based on their proportionate shares of volume of dredged material to be delivered to the project site. Utilizing Scenario 3, the excess transportation costs for the HWRP would be approximately $12.8 MIL.

The adjustments to the HWRP costs define the total HWRP implementation costs if the HWRP were to be constructed without the BMK V expansion. There costs are shown below:

Adjusted Total HWRP Implementation Costs

($MIL)

	Total Project Cost (1998$)	Adjusted Total Project Implementation Cost (2002$)
Lands, Easements, Rights of Way	0.3	0.4
Relocations	2.1	12.6
PED	4.1	16.3
Site Prep	19.3	19.6
Navigation Ports & Harbors	27.8	n/a
Offload/Placement	n/a	54.4
Excess Transportation Costs	n/a	12.9
Adaptive Management	1.5	2.8
Total	55.2	119.0

6.9.3 Oakland Deepening Project Contribution to HWRP Implementation Costs

The HWRP and the Oakland 50-foot deepening project were both authorized in WRDA 1999. WRDA 1999 authorized both projects to place Oakland dredged material at the HWRP. The HWRP was authorized to share site preparation and offload/placement costs with navigation projects using the site, by accepting funding contributions from the Oakland Deepening Project, among others. The Oakland Harbor Navigation Improvement (-50-Foot) Project Cooperation Agreement (PCA), which was signed in July of 2001, requires the Oakland Project to contribute 100% of the PED, site preparation, and offload/placement costs associated with placing that volume of material dredged from the Deepening Project and delivered to the HWRP, which the Oakland Project authorization estimated at 2.5 mcy. This requirement does not apply to Oakland maintenance material.

The Oakland Deepening Project is generally assigned the funding responsibility for approximately 25% of the costs of beneficial use at the HWRP; of this proportion, the Oakland PCA estimates that the Oakland Project's share of the Hamilton site preparation costs (not including Hamilton's offload and placement costs) will be $5.2 MIL. The Oakland contributions are based on the following assumptions:

a. The Oakland Project will deliver all 2.5 mcy to HWRP.
b. The Oakland Project's share of costs is computed based on its proportional contribution to total cubic yardage delivered to the HWRP site (2.5 mcy/10.6 mcy = 23.58%).
c. The Oakland Project is expected to contribute 23.58% of the estimated total volume of dredged material to be placed on the HWRP site. A 23.58% fraction of the site preparation, PED and construction management, relocations, lands and damages, and offload/placement costs has been calculated for attribution to the Oakland Project. The Oakland Project is not responsible for paying any portion of excess transportation costs associated with other navigation projects.

Based on the adjusted total HWRP implementation costs, the Oakland Deepening Project will contribute approximately $25 million toward the HWRP costs, leaving the remaining $94 million to be funded by the HWRP and other navigation projects using the site.

Oakland Deepening Project Contribution to HWRP Total Project Implementation Cost ($MIL)

	Adjusted Total HWRP Implementation Cost (2002$)	Oakland Deepening Project Contribution (2002$)
LERs	0.4	0.1
Relocations	12.6	3.0
PED & Construction Costs	16.3	3.8
Site Prep	19.6	4.6
Offload/Placement	54.4	12.8
Excess Transportation Costs	12.9	N/A
Adaptive Management	2.8	0.7
Total	119.0	25.0

6.9.4 Total Implementation Costs for Combined HWRP and BMK V Project

The following table displays the estimated total project implementation costs for the combined HWRP/BMK V project. The cost figures for the BMK V portion are presented in Chapter 5 of this report.

Total Project Implementation Costs
($MIL)
(2002$)

	HWRP	BMK V	Combined Project
LERs	0.4	19.4	19.8
Relocations	12.6	0.3	12.9
PED & Construct. Mgmt	16.3	22.4	38.7
Site Prep	19.6	40.4	60.0
Offload/Placement	54.4	79.6	134.0
Excess Transport. Cost	12.9	16.7	29.6
Recreation	0.0	0.2	0.2
Adaptive Management	2.8	3.7	6.5
Total	119.0	182.7	301.7

6.9.5 Other Navigation Project Contributions to HWRP/BMK V Combined Project Implementation Costs

The total project implementation costs for the Combined HWRP/BMK V Project will be funded through the HWRP/BMK V Project, the Oakland Deepening Project, and the other navigation projects using the project site. The Oakland Deepening Project's contribution is estimated to be $25 million, as detailed above.

As discussed previously, those other Federal and non-Federal navigation projects designated under the LTMS Implementation Plan to dispose of dredged material at SFDODS will contribute funding to the HWRP. The funding contribution will be calculated as a cost differential: the difference between the estimated costs of dredging, transportation to and disposal at SFDODS, and the actual costs of dredging and transportation to Hamilton. The schedule of material to be delivered to the site from other navigation projects is presented in Table 2 provided at the end of Appendix A. These quantities were used to compute the funding contribution to the HWRP from navigation projects presently disposing of dredged material at SFDODS.

The total project implementation cost for the combined project forms the basis for the total first project cost, which defines the cost-sharing contributions. The Oakland Deepening Project's contribution and the other navigation projects' contributions must be subtracted from the total project implementation cost to determine the total project first cost. This is necessary to avoid redundant Federal appropriations covering identical components of both the HWRP and other Federal navigation projects, and to account for contributions to the HWRP's total project implementation costs derived from non-Federal navigation projects providing funding to the HWRP as determined by those projects' transportation costs differential. As shown in the table below, the total first project cost for the combined HWRP/BMK V project is $188.3 MIL, and this figure will form the basis of cost-sharing. The total project first cost is equivalent to the project's "construction general" funding cost. The total project first cost is $133.0 MIL greater than the original authorized amount of $55.2 MIL.

Total Project First Costs
($MIL)

Total Project Implementation Cost for Combined Project	Oakland Project's Contribution	Other Navigation Project Contributions	Total Project First Cost
$301.7 million	$25.0 million	$88.4 million	$188.3 million

6.9.6 Changes to Total Project First Costs for Combined HWRP and BMK V Project

The following table displays the estimated costs for the combined HWRP/BMK V project, the HWRP project as authorized by WRDA 1999, the authorized project updated to current price levels, and the project last recommended to Congress.

Changes in Total Project First Costs
($MIL)

Recommended Project Costs (2002 $)	Authorized (WRDA 99) (1998 $)	Updated Authorized Costs (2002 $)	Costs Last Presented to Congress (2001$)
$188.3	$55.2	$119.0 1/	$63.2

1/ The updated authorized costs presented here are the HWRP adjusted project implementation costs.

TABLE A-1
COMPUTATION OF
EXCESS AND DIFFERENTIAL TRANSPORTATION COSTS
BETWEEN CURRENT DISPOSAL SITES AND HAMILTON SITE
FOR COMBINED HWRP/BMK PROJECT
(Excludes Costs Associated with Site Preparation, PED, or LERRDs)

			Current Disposal Site Costs			Hamilton Disposal Site Costs: Dredge & Haul Costs		Hamilton Disposal Site Costs: Offload Costs		Hamilton Disposal Site Costs: Total Costs			
	No. Dredging Episodes	Volume Material for HWRP/BMK thru 2015 (mcy)	Unit Cost to Dredge & Haul, Excluding Mob/Demob ($/cy)	Mob/Demob Cost per Dredging Episode ($/cy)	Cumulative Ocean or In-Bay Site Dredge & Haul Cost thru 2015 ($/cy)	Unit Cost to Dredge & Haul, Excluding Mob/Demob ($/cy)	Mob/Demob Cost per Dredging Episode ($/cy)	Unit Cost of Offloading Operation ($/cy)	Unit Cost of Offloading mob/Demob ($/cy)	Cumulative HWRP/BMK Dredge/Haul and Offload Cost thru 2015 ($/cy)	Total Offload Operating & Mob/Demob Cost for HWRP/BMK	Excess Transportation Cost (Additional Cost to Haul to HWRP Site from In-Bay Site)	Differential Transportation Cost (Cost Savings to Haul to HWRP Site from Ocean Site)
	B	C	E	F	G	I	J	K	L	M	O	Q	R
					(E*C+F*B)					(I*C)+(J*B)+(K+L)*C	(K+L)*C	M-O-G (Positive Values)	M-O-G (Negative Values)
Federal Projects													
Ocean Sites													
Oakland (O&M)	12	4.858	$ 12.74	$ 546,120	68,444,360	$ 6.45	$ 442,682	$ 1.54	$ 0.74	$ 47,715,604	11,069,320		$ (31,798,076)
Richmond	12	4.608	$ 13.05	$ 543,972	66,662,064	$ 5.21	$ 258,000	$ 1.52	$ 0.69	$ 37,275,840	10,172,160		$ (39,558,384)
Oakland -50' .	1	2.5	$ 11.47	$ 3,025,000	31,700,000	$ · 6.81	$ 2,906,000	$ 2.83	$ 0.12	$ 27,304,000	7,373,000		n/a (Note B)
In-Bay Sites													
Pinole Shoal	6	1.188	$ 6.04	$ 234,230	8,580,900	$ 6.01	$ 258,000	$ 2.76	$ 1.33	$ 13,550,760	4,862,880	$ 106,980	
Redwood City	4	1.728	$ 7.77	$ 320,124	14,707,056	$ 7.66	$ 425,000	$ 1.54	$ 0.69	$ 18,793,600	3,857,120	$ 229,424	
Southampton Shoal	12	3.3	$ 3.36	n/a (Note A)	11,088,000	$ 5.21	$ 258,000	$ 1.52	$ 0.96	$ 28,473,000	8,184,000	$ 9,201,000	
					$ 201,182,380					**$ 173,112,804**	**$ 45,518,480**	**$ 9,537,404**	**$ (71,356,460)**
Non-Fed Projects													
Ocean Sites													
Oakland Berths	12	1.08	$ 12.74	$ 546,120	20,312,640	$ 6.45	$ 442,682	$ 1.54	$ 3.32	$ 17,529,384	5,251,200		$ (8,034,456)
Richmond Berths	4	0.2	$ 13.05	$ 543,972	4,785,888	$ 5.21	$ 258,000	$ 1.52	$ 5.28	$ 3,434,000	1,360,000		$ (2,711,888)
In-Bay Sites													
Chevron	12	1.44	$ 3.52	$ 287,000	8,512,800	$ 5.81	$ 258,000	$ 1.52	$ 2.20	$ 16,819,200	5,356,800	$ 2,949,600	
Larkspur	6	1.425	$ 3.52	$ 287,000	6,738,000	$ 10.83	$ 300,000	$ 3.40	$ 1.26	$ 23,871,750	6,639,000	$ 10,494,750	
Port of S.F.	12	2.136	$ 3.52	$ 287,000	10,962,720	$ 5.81	$ 258,000	$ 1.52	$ 1.68	$ 22,340,880	6,834,720	$ 4,543,440	
					$ 51,312,048					**$ 83,995,214**	**$ 25,441,720**	**$ 17,987,790**	**$ (10,746,344)**
Subtotals		24.46			**$ 252,494,428**					**$ 257,108,018**	**$ 70,960,200**	**$ 27,525,194**	**$ (82,102,804)**
Adjustments			Add offloader electrification, standby and contingencies & excess trans cost contingencies.								$ 59,167,800	$ 4,500,000	$ -
Subtotal			Subtotal of offload costs. (LTMS base case)								$ 130,128,000	$ 32,025,194	$ (82,102,804)
LTMS Adjustments			Less $2.4M excess trans costs & increase diff. trans costs by $6.3M to account for phase-in of LTMS.								$ -	$ (2,407,000)	$ (6,320,000)
Totals											**$ 130,128,000**	**$ 29,618,194**	**$ (88,422,804)**

NOTE A: Southampton dredging costs include mob/demob costs for hopper dredging.
NOTE B: Oakland 50' costs are provided by the Oakland 50' project, rather than by HWRP.

TABLE A-2
VOLUMES FOR PROJECTS WITH IN-BAY DISPOSAL SITES ADJUSTED TO ACCOUNT FOR LTMS SHIFT FROM IN-BAY TO OCEAN DISPOSAL

(1,000 CY)
($1,000)

	<-25% LTMS Implementation->			<--50% LTMS Implementation->			<---75% LTMS Implementation--->			<----------------100% LTMS Implementation---------------->					
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
FEDERAL O&M PROJECTS WITH PRE-LTMS IN-BAY DISPOSAL															**(1,000 cy)**
Pinole Shoals[1]	0	0	0	198	0	198	0	198	0	198	0	198	0	198	**1,188**
Redwood City Harbor[1]	0	0	0	432	0	0	432	0	0	432	0	0	432	0	**1,728**
Southampton Shoals	0	0	275	275	275	275	275	275	275	275	275	275	275	275	**3,300**
TOTAL	0	0	275	905	275	473	707	473	275	905	275	473	707	473	**6,216**
RUNNING TOTAL	0	0	275	1,180	1,455	1,928	2,635	3,108	3,383	4,288	4,563	5,036	5,743	6,216	
NON-FEDERAL PROJECTS WITH PRE-LTMS IN-BAY DISPOSAL															**(1,000 cy)**
Chevron	0	0	120	120	120	120	120	120	120	120	120	120	120	120	**1,440**
Larkspur Ferry Channel[2]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Port of San Francisco	0	0	178	178	178	178	178	178	178	178	178	178	178	178	**2,136**
TOTAL	0	0	298	298	298	298	298	298	298	298	298	298	298	298	**3,576**
RUNNING TOTAL	0	0	298	596	894	1,192	1,490	1,788	2,086	2,384	2,682	2,980	3,278	3,576	
ANNUAL TOTAL	0	0	573	1,203	573	771	1,005	771	573	1,203	573	771	1,005	771	**9,792**
ANNUAL RUNNING TOTAL	0	0	573	1,776	2,349	3,120	4,125	4,896	5,469	6,672	7,245	8,016	9,021	9,792	
Scenario 1: Assumes no in-bay material shifts to SFDODS. (Base case)															**(1,000 cy)**
ANNUAL GRAND TOTAL			573	1,203	573	771	1,005	771	573	1,203	573	771	1,005	771	**9,792**
LTMS VOLUME TO SHIFT TO SFDODS			0	0	0	0	0	0	0	0	0	0	0	0	**0**
VOLUME TO REMAIN IN-BAY			573	1,203	573	771	1,005	771	573	1,203	573	771	1,005	771	**9,792**
															($1,000)
Decrease to Excess Trans. Cost			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
Increase to Cost Differntial			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
Scenario 2: Assumes in-bay material shifts to SFDODS up to LTMS implementation percentage.															**(1,000 cy)**
ANNUAL GRAND TOTAL			573	1,203	573	771	1,005	771	573	1,203	573	771	1,005	771	**9,792**
LTMS VOLUME TO SHIFT TO SFDODS			143	602	287	386	754	578	430	1,203	573	771	1,005	771	**7,502**
VOLUME TO REMAIN IN-BAY			430	602	287	386	251	193	143	0	0	0	0	0	**2,291**
															($1,000)
Decrease to Excess Trans. Cost			$ 458	$ 1,921	$ 915	$ 1,231	$ 2,407	$ 1,847	$ 1,373	$ 3,842	$ 1,830	$ 2,463	$ 3,210	$ 2,463	**$ 23,959**
Increase to Cost Differntial			$ 1,201	$ 5,043	$ 2,402	$ 3,232	$ 6,320	$ 4,848	$ 3,603	$ 10,087	$ 4,804	$ 6,465	$ 8,427	$ 6,465	**$ 62,898**
Scenario 3: Assumes In-Bay material shifts to SFDODS, but also assumes 750K cy/yr remains exempt from SFDODS (remains in-bay).															**(1,000 cy)**
ANNUAL GRAND TOTAL			573	1,203	573	771	1,005	771	573	1,203	573	771	1,005	771	**9,792**
LTMS VOLUME TO SHIFT TO SFDODS			0	0	0	0	4	0	0	453	0	21	255	21	**754**
VOLUME TO REMAIN IN-BAY			573	1,203	573	771	1,001	771	573	750	573	750	750	750	**9,038**
lumes less than 750K cy are assumed to all remain in-bay															**($1,000)**
Decrease to Excess Trans. Cost			$ -	$ -	$ -	$ -	$ 12	$ -	$ -	$ 1,447	$ -	$ 67	$ 814	$ 67	**$ 2,407**
Increase to Cost Differntial			$ -	$ -	$ -	$ -	$ 31	$ -	$ -	$ 3,798	$ -	$ 176	$ 2,138	$ 176	**$ 6,320**

Weighted Avg Excess Trans Cost $ 3.19 Excess Trans Cost from Column "Q" of Table A-1 / total in-bay volume (excludes Larkspur)
Weighted Avg Differential Costs $ 8.38 Differential Cost from Column "R" of Table A-1 / total in-bay volume (excludes Larkspur)

[1]Dredge predictions provided by USACE in scope
[2]Larkspur Ferry Channel assumed to be exempt from LTMS due to unlikely cost-effectiveness of shallow draft ocean disposal.

4/17/03

Appendix B

HTRW

(Phase I Report and Results of Shallow Soil Investigation)

Erler &
Kalinowski, Inc.

PHASE I PRELIMINARY ENVIRONMENTAL SITE ASSESSMENT FOR CALIFORNIA QUARTET PROPERTY BEL MARIN KEYS UNIT V MARIN COUNTY, CALIFORNIA

5 May 2000
EKI A00018.00

CALIFORNIA QUARTET PROPERTY
MARIN COUNTY, CALIFORNIA
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EXECUTIVE SUMMARY

On behalf of California Quartet, LLP, Erler & Kalinowski, Inc. ("EKI") performed a Phase I preliminary environmental site assessment for the property known as the California Quartet Property Bel Marin Keys Unit V, located adjacent to Bel Marin Keys, Marin County, California ("subject property"). This assessment was performed in accordance with the Agreement between EKI and California Quartet, LLP dated 7 March 2000. A summary of the findings of this assessment is presented below.

ES.1 Land Use and Environmental Investigations on the Subject Property

Based on available historical information reviewed by EKI, the subject property has been in agricultural use (i.e., oat hay and tomato farming) for many decades. Prior to agricultural use, the subject property was likely a tidal marsh. Approximately a dozen structures currently exist on the subject property. These include residential buildings associated with Headquarters Hill located at the extreme western edge of the subject property, an old rectangular shed located in the southwest portion of the subject property, and an old residence and rectangular building located in the north central portion of the subject property. The northeastern portion of the subject property has also been used for placement of dredge spoils from Bel Marin Keys.

Potential environmental concerns identified in association with current and historical uses on the subject property include: (a) the use of herbicides and/or pesticides for weed and bug control, (b) the presence/use of fuel storage tanks for vehicle filling, and (c) the presence of debris piles in the northeastern corner of the subject property. A summary of each of these issues is presented below. In addition, a summary of results of mercury sampling of dredge spoils conducted by Advanced Biological Testing, Inc. is presented in section ES.1.3. Sampling of dredge spoils was conducted to evaluate if mercury concentrations present in these spoils could adversely impact wetland species if the property is converted into wetland in the future.

ES.1.1 Potential Chemical Use

Information obtained regarding the subject property and the predominantly agricultural use of the subject property, indicates that pesticides and herbicides were likely applied to surface soil on this property. However, results of soil sampling conducted across the central and western portions of the subject property in 1989 did not identify the presence of detectable concentrations of organochlorine pesticides, herbicides, PCBs, or petroleum hydrocarbons in shallow soil samples, including the herbicide 2,4-D which is reported to have been used on the subject property in the 1980's. Therefore, widespread impacts to soil on the subject property of these compounds are unlikely.

No testing of soil on the subject property was conducted for potentially toxic degradation products of 2,4-D (e.g., 2,4-dichlorophenol) or potential contaminants found in some manufactured forms of 2,4-D (i.e., dioxins; Industry Task Force, 1999). Therefore, although concentrations of these compounds would likely be very limited due to their susceptibility to

degradation and/or limited initial concentrations, these byproducts of 2,4-D could still be present in shallow soil on the subject property.

In addition, no sampling for potential chemicals of concern has been conducted near the sheds identified on the subject property. These sheds may have been used to store pesticides and herbicides as well as petroleum hydrocarbons (i.e., fuels and oils) and solvents (i.e., degreasing solvents), which may have been used in association with farm equipment maintenance and repair. Therefore, if soil in the vicinity of these sheds contains residual concentrations of petroleum hydrocarbons, solvents, and or agricultural chemicals it would not have been detected during the prior soil sampling conducted on the subject property.

ES.1.2 Fuel Storage Tanks

A previous environmental assessment conducted by Blymyer indicated the presence of two above ground fuel tanks and dispenser off the southern base of Headquarters Hill. At the time of the current walk through, the only remaining remnant of this former fueling area was the concrete pad. No visible signs of fuel releases (i.e., staining or odors) were observed during the walk through. However, no tank closure documentation was identified at the local agencies. Additionally, no soil or groundwater sampling has been conducted at this location.

One above ground storage tank was also observed at the southern base of Headquarters Hill, near a mobile home residence. This tank was approximately 3 feet in diameter and 4 feet in length and was situated on wooden blocks. The tank was not in use and appeared as if it had been stored at this location for some time. Tapping of the sides of the tank resulted in a hollow sound, indicating the tank was empty or almost empty. No visible signs of fuel releases were observed at this location. However, no soil or groundwater sampling has been conducted at this location.

ES.1.3 Debris Piles

The 1994 Miller Pacific Engineer Group Phase I report for the subject property indicated the presence of a refuse pile located in the northeastern corner of the subject property and a pile of tires in the eastern portion of the subject property. Both piles were located on the bay side of the levee. Due to access constraints at the time of EKI's walk-through of the subject property, these refuse piles were not observed by EKI. No visual observations of obvious hazardous materials were reported by the Miller Pacific Engineer Group.

ES.1.3 Mercury Sampling of Dredge Spoils

In March 2000, sampling for mercury and methyl-mercury was conducted. Samples were collected from dredge spoils located in the northeastern portion of the property and which originated from the Bel Marin Keys. Results of the sampling indicate mercury concentrations range from 0.181 to 0.496 milligrams per kilogram ("mg/kg"), and methyl-mercury concentrations range from 0.001 to 0.0325 mg/kg in shallow soils in the northeastern portion of the subject property. Mercury and methyl-mercury concentrations detected in these samples are below their U.S. Environmental Protection Agency ("EPA") Region 9 Residential Preliminary Remediation

Goals ("PRGs") of 23 mg/kg and 6.1 mg/kg, respectively (U.S. EPA, 1999). The Residential PRGs are human health-risk based goals that are calculated using standard EPA human health exposure assumptions for residential use. These goals are based on a target incremental cancer risk of one in a million and a hazard index of one, which ever is more stringent. Therefore, concentrations of mercury and methyl-mercury detected in these soil samples are not likely to create a significant risk to human health. These results are being reviewed by the U.S. Corps of Engineers and environmental regulatory agencies in association with the potential conversion of the subject property into a wetland.

ES. 2 Potential Environmental Impacts from Nearby Sites

Hamilton Army Airfield ("HAA") and four additional chemical release sites located generally upgradient from the subject property were identified based upon a review of agency files. A summary of potential environmental impacts from these sites on the subject property are described below.

ES.2.1 Hamilton Armv Airfield ("HAA")

A number of chemical releases to soil and groundwater have occurred on the Hamilton Army Airfield ("HAA") site, which is located adjacent to and south of the subject property. Chemical releases identified at HAA primarily consist of petroleum hydrocarbon compounds. Volatile organic compounds ("VOCs"), semi-volatile organic compounds, polychlorinated biphenyls, and methyl tertiary butyl ether ("MTBE") have also been detected in some areas. The HAA site is being investigated and remediated by the Army under the oversight of the Department of Toxic Substances Control ("DTSC") in conjunction with the Regional Water Quality Control Board ("RWQCB"), and the U.S. EPA. The remedial investigation of HAA is generally complete and a risk assessment, which identifies screening levels for cleanup has been submitted to the regulatory agencies for review (verbal communication with Lance McMann the current DTSC project officer for HAA). The northern portion of HAA, which is located adjacent to the subject property is proposed for restoration as a wetland (California State Coastal Conservancy and U.S. Army Corps of Engineers, 1998).

Eight potential chemical release sites have been identified on the HAA site near (i.e., within 2000 feet) and potentially upgradient of the subject property. Chemicals detected in soil at these sites include petroleum hydrocarbons, volatile organic compounds, semi-volatile organic compounds, polychlorinated biphenyls, methyl tertiary butyl ether, and polynuclear aromatic hydrocarbons. Results of soil and groundwater investigations conducted at these sites indicate the following:

(a) Chemically impacted soil is generally limited to within 50 feet of the release sites (IT Corporation, April 1999) and has not been found to extend onto the subject property. In addition, a perimeter ditch and/or levee separate the HAA site from the subject property; therefore, migration of impacted soil from HAA onto the subject property is unlikely.

(b) No significant groundwater chemical plumes have been identified from chemical releases on the HAA (oral communication with Susan Gladstone of the RWQCB). Therefore, impacts to groundwater on the subject property from releases at these sites are unlikely.

- In addition to these potential chemical release sites identified on HAA, a groundwater plume has been identified beneath a portion of the HAA. This plume contains MTBE, and originates at a gasoline station within the Navy housing area located south of the former runway area, approximately 5000 feet from the subject property. It is being investigated by the Navy under the oversight of the RWQCB. The plume is migrating in a northeasterly direction and significant migration of this plume has occurred, however, it does not currently extend north or east of Ammo Hill, which is located approximately 1,500 feet south of the subject property. Therefore, this plume is not currently impacting groundwater beneath the subject property. However, if this plume is not remediated and additional significant migration of this plume occurs, it could migrate onto the subject property in the future. Discussions with RWQCB staff indicate that continued monitoring and potential remediation of this plume are likely to be required. A tentative RWQCB order was recently issued for this area (oral communication with Susan Gladstone and Jim Ponton of the RWQCB).

ES.2.2 Other Nearby Sites

A government database search identified four additional chemical release sites located generally upgradient from the subject property. However, given the distance of these release sites to the subject property, approximately three-quarters of a mile, and the nature of chemicals detected (e.g. generally petroleum products which tend to degrade readily), impacts to the subject property from these releases are not expected.

1.0 INTRODUCTION

Erler & Kalinowski, Inc. ("EKI") was retained by California Quartet, LLP, to perform a Phase I preliminary environmental site assessment of approximately 1,600 acres of property known as the California Quartet Property Bel Marin Keys Unit V ("subject property") in Marin County, California. The subject property is bounded along the east by San Pablo Bay, along the north and west by the existing Bel Marin Keys Units I-IV residential development and Novato Creek, and along the south and southeast by Hamilton Army Airfield ("HAA") and State lands, respectively (see Figure 1). The north-westernmost portion of the subject property (referred to as Headquarters Hill) is bounded to the west by a wetland area maintained by the Marin County Flood Control and Water Conservation District (see Figure 2).

This Phase I preliminary environmental site assessment, in general, follows the procedures outlined in the American Society for Testing and Materials ("ASTM") *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process*, Designation E 1527-97 (published May 1997). The purpose of this assessment is to identify significant potential environmental concerns, if any, associated with the subject property related to past or present on-site land uses and nearby off-site land uses. This assessment is based on information obtained from the following sources:

- review of available historical land use information for the subject property and vicinity, including historical aerial photographs dated between 1950 and 1999;

- review of a computer database search of agency lists identifying reported chemical use and release sites at the subject property and surrounding areas;

- review of available file information at the California Regional Water Quality Control Board, California Department of Toxics Substances Control, Marin County Environmental Health Department, and City of Novato Fire Department;

- observations made during a walk-through of the subject property and vicinity on 29 March and 18 April 2000, and discussions with Ms. Sylvia Brenner, consultant for the current property owner, and

- review of various environmental documents pertaining to the subject property and surrounding areas, which are referenced in Section 5.0 of this report. These reports include results of shallow soil sampling on the subject property performed in 1989 and 2000. Additionally, two previous environmental site assessments were performed for the subject property in 1989 and 1994.

No soil, groundwater, or building materials samples were collected by EKI as part of this assessment. The conclusions and recommendations presented herein are our professional opinion and are not a warranty or guaranty as to the presence, absence, or extent of

contamination at the subject property or of releases from or near the subject property. The facts presented herein are based on available information obtained by EKI and represent existing conditions at the subject property at the time of this report. This report is for the sole use of California Quartet, LLP. Unless specifically authorized by EKI, use of or reliance on this report by any other entity is not permitted or authorized.

2.0 DESCRIPTION OF SUBJECT PROPERTY AND VICINITY

2.1 Subject Property

The subject property is located in Marin County west of San Pablo Bay, south of Novato Creek, east/southeast of the Bel Marin Keys residential community, and north of the former Hamilton Army Airfield (see Figure 1). The majority of the 1,600-acre site is situated below mean sea level ("MSL") and is currently and has historically been utilized for farming. The subject property is traversed by drainage ditches, and by levees located along Novato Creek, San Pablo Bay, the Bel Marin Keys residential community, and the boundary with the State Lands abutting the southeastern portion of the subject property. A pump station exists along the eastern property boundary adjacent to San Pablo Bay (see Figure 2). This pump station pumps surface water drainage and groundwater from the subject property to the Bay. The pump station can be accessed by an existing levee which traverses the central portion of the subject property in an east-west direction.

Improvements on the subject property include approximately a dozen structures – occupied residential buildings associated with Headquarters Hill, and old and unoccupied buildings in the western and central portions of the subject property (discussed further in Section 4.0). Other improvements on the subject property include above ground power transmission lines.

2.2 Surrounding Areas

The subject property is bordered to the south by the former Hamilton Army Airfield ("HAA"). The HAA was constructed and first utilized by the military in the 1930s. Southeast of the subject property are the HAA North Antenna Field ("NAF") facilities which are reported to have been used as a radar facility, military communications, a rifle and gun range, and burn pits reportedly used for fire fighting training (see Figure 2).

North and west of the subject property are the Bel Marin Keys Units I-IV residential subdivisions. The northern residential areas were initially constructed in the 1960s, and expanded to the south in the 1980s. Novato Creek also borders the subject property to the north. This creek has been dredged to provide boat access to Bel Marin Keys (personal communication with Sylvia Brenner).

A wetland area owned by the Marin County Flood Control and Water Conservation District is located west of the westernmost portion of the subject property. San Pablo Bay borders the subject property to the east.

2.3 Site Topography and Hydrogeology

The elevation of the ground surface over the majority of the subject property is approximately four feet below mean sea level. The crest of Headquarters Hill is approximately 40 feet above mean sea level. Surface water and groundwater are collected in drainage ditches which cross the

subject property. This water is discharged to San Pablo Bay via a pump located in the eastern portion of the subject property (see Figure 2).

The majority of the subject property is underlain by Bay Mud consisting of clays and silty clays with occasional lenses of sand and sandy clays and some organic and shell deposits. The thickness of the Bay Mud reportedly ranges from zero feet near Headquarters Hill to approximately 100 feet near the Bay margin. The Bay Mud is underlain by sedimentary deposits, and sandstone and shale of the Franciscan Formation.

For the majority of the property, groundwater is maintained below the ground surface through the use of the drainage paths and pump station. The direction of shallow groundwater flow is likely toward Novato Creek and/or San Pablo Bay (i.e., north to northeast across the subject property). The magnitude of the hydraulic gradient across the subject property may be limited due to the proximity of the Bay.

3.0 LAND USE HISTORY

Information on historical land use of the subject property and surrounding areas was obtained from the review of available historical aerial photographs at Pacific Aerial Surveys in Oakland, California. EKI reviewed aerial photographs for the subject property and surrounding areas for the years listed below:

• November 1950	March 1980
• March 1958	May 1982
• April 1966	April 1986
• July 1970	March 1990
• January 1972	April 1992
• April 1975	August 1995
	February 1999

The following is a brief summary of the land use history of the subject property and vicinity based on available historical information reviewed by EKI.

3.1 Prior to 1950s

Western Ecological Services Company, Inc. ("WESCO") prepared *A Cultural Resources Assessment for the Bel Marin Keys Unit V Residential Development*, dated August 1992. This report provided a history of the subject property. According to WESCO, the subject property was first acquired from the State of California by Henry Hansen in 1868, and deeds through 1870 refer to a brickyard on the property. No evidence of the existence of a brickyard has been identified in recent assessments or investigations. An 1876 land transaction deeded the property to E.B. Perrin. This deed refers to two-story brick house, stables and other improvements, which is likely located in the area now referred to as Headquarters Hill. Headquarters Hill was the farming headquarters for subsequent landowners. John W. Ferris owned the property between 1878 and 1912. Ferris was a developer involved in the constructions of levees and canals for properties in other counties he owned; it is likely the levees on the subject property were constructed during his ownership. The dwelling and associated outbuildings located in the north central portion of the property were likely constructed prior to 1887, when they first appeared on maps. It is likely that Ferris rented this property to sharecroppers. The pumphouse on the eastern edge of the property was likely constructed prior to 1916, when it first appears on maps.

California Packing Corporation ("CPC") owned on the property from 1916 through 1948. CPC raised sugar beets, peas, and other crops; and bred stallions which were also used in farm work. Irrigation for crops was provided by onsite irrigation wells which have since been abandoned due to saltwater intrusion. The locations of these wells are unknown. If these wells still exist, such wells could provide vertical pathways for migration of groundwater and chemicals, if present.

The additional structures at Headquarters Hill and the barn located south of Headquarters Hill were likely constructed during CPC's tenure in the 1940s (WESCO, 1992).

3.2 1950s and 1960s

In the 1950s aerial photographs, the subject property appears generally as it does at the present time. The subject property is in agricultural use and is bisected by a number of drainage ditches. Reportedly, tomatoes were farmed at the subject property in the 1950s, followed by a few years where the land was fallow (personal communication with Jens Kuhlberg, current lessee of the subject property). Oat hay has been farmed at the subject property since the late 1950s to the present.

The buildings on Headquarters Hill are evident as well as a rectangular shed in the southwest portion of the subject property, and an apparent residence and rectangular shed in the north central portion of the subject property. The use of the rectangular shed in the north central portion of the property cannot be discerned from review of the aerial photos, but its use may be related to on-site agricultural activities (i.e., equipment or agricultural chemical storage and/or maintenance sheds).

South of the subject property, HAA is visible as well as features on the North Antenna Field ("NAF"), including the rifle and gun range, and two to three apparent antenna arrays. Approximately half a dozen areas of ground surface disturbance are noted in the NAF area, with one area located in the extreme western portion of the NAF area, adjacent to the subject property boundary. Based on information obtained from prior assessments for the subject property and the HAA, it is possible these ground surface disturbance areas are burn pits. Units I through III of the Bel Marin Keys residential subdivision first become evident in the 1966 aerial photograph.

3.3 1970s through 1990s

In the 1972 aerial photograph, apparent filling activities are occurring in the extreme western portion of the subject property, immediately southeast of Headquarters Hill. In the 1990 aerial photograph, an apparent crop-dusting airplane is observed adjacent to the buildings in the north-central portion of the subject property. Approximately three truck trailers, including possibly a tanker trailer, are also observed in this area. Land uses on the subject property and adjacent areas appear to change little during the 1970s through 1990s, with the exception of the construction of Unit IV of Bel Marin Keys, which is visible in the 1982 aerial photograph.

Discussion with Mr. Jens Kuhlberg, who has farmed the subject property since approximately 1980, indicated use during his tenure of 2,4-D, an herbicide. Mr. Kuhlberg indicated that in the 1980s, 2,4-D was applied by crop dusting with a small aircraft, however, no storage or mixing of 2,4-D occurred on the subject property. Use of 2,4-D ceased in 1990 or 1991. Mr. Kuhlberg indicates no herbicides or pesticides have been in use at the subject property since that time.

4.0 WALK-THROUGH OF SUBJECT PROPERTY

A walk-through of the subject property was performed by Meg Mendoza of EKI on 29 March and 18 April 2000. The following is a brief discussion of observations made during the walk-through of the subject property.

The main entrance to the farming area of the subject property is a levee road that runs east-west, abutting the Bel Marin Keys residential area. At the time of the walk through, the main levee road was being used for recreational purposes including fishing and as a jogging trail. To the west of this entry road is Headquarters Hill. Two additional dirt roads curve off to the west. A small waterway separates these two dirt roads. One road leads to a trailer residence at the base of Headquarters Hill, and the other leads to a barn on the western side of the property (see Figure 2).

The barn is located in a wooded area and is in a state of disrepair. A few used oil filters and one container (approximately 20 gallons) labeled as lube oil were situated outside the barn. An empty trash container and some plastic sheeting were also located in this area. Oat hay was stored in the interior of the barn.

The subject property is largely used for farming of oat hay. The hay fields are separated by either levees or drainage ditches. Hay fields in the southern and northern portions of the site were planted. Hay fields in the southeastern portion of the site were being worked by farm equipment (disking and spring tooth equipment pulled behind tractors).

The borrow pits which exist east of the Bel Marin Keys residential area (see Figure 2) contained water at the time of the walk-through.

Three structures, one apparent former dwelling and two sheds, are located in the north central portion of the subject property (see Figure 2). All three structures are in a state of disrepair.

Due to recent rains the easternmost portions of the subject property were not accessible during the walk-through. A previous site assessment, prepared by Miller Pacific Engineer Group ("Miller") in 1994, noted a debris pile located in the northeastern corner of the subject property outside the levee, and a pile of tires located outside the levee on the eastern portion of the subject property. No obvious hazardous materials were reported. EKI was unable to access these areas, but we presume the debris piles are still in place.

Headquarters Hill is located on a slight knoll in the northwestern portion of the property. Several structures exist on Headquarters Hill including a main residence, a garage with living unit above, a tower, a bunkhouse, a studio, and two mobile homes. Various outbuildings also exist including a storage shed and a pool equipment shed. A discussion with Mr. Ron Webster, who lives on Headquarters Hill, indicates previous uses of the tower may have been (1) as a water tower to provide gravity feed for pumped well water and (2) as an observation tower by the Hamilton Army Airfield. Further discussion indicated the property had been used as a working ranch

historically. A concrete footing (approximately 10 feet by 10 feet) existed to the northeast of the tower. The use of this footing is unknown.

At the southern base of Headquarters Hill and west of the main levee road, exists a square concrete equipment pad, and partially buried oblong extension. Review of previous reports prepared by Miller and Blymyer (1989) indicate this is the likely location of two former above ground storage tanks and dispenser. Discussion with Mr. Ron Webster indicated the dispenser was used during ranching activities at the subject property. The tanks and dispenser were removed from this location sometime between 1989 and 1994. No visible signs of fuel releases (i.e., staining or odors) were observed at this location. However, no tank closure documentation was identified at the local agencies. Additionally, no soil or groundwater sampling has been conducted at this location.

One above ground storage tank was observed at the southern base of Headquarters Hill, near a mobile home residence. This tank was approximately 3 feet in diameter and 4 feet in length and was situated on wooden blocks. The tank was not in use and appeared as if it had been stored at this location for some time. Tapping of the sides of the tank resulted in a hollow sound, indicating the tank was empty or almost empty. No visible signs of fuel releases were observed at this location. However, no soil or groundwater sampling has been conducted in this area. Other materials and debris are stored at Headquarters Hill, including a go-cart, a sailboat, engine parts, and metal refuse.

5.0 RESULTS OF PRIOR SUBSURFACE INVESTIGATIONS ON THE SUBJECT PROPERTY

5.1 Blymyer Engineers Soil Sampling (1989)

In 1989, Blymyer Engineers, Inc. sampled the soil at 22 locations throughout the southwestern and central portions of the subject property. The soil samples were collected at approximately 12-inches below ground surface. Composite soil samples were analyzed for total petroleum hydrocarbons ("TPH") as diesel, PCBs, organochlorine pesticides, and herbicides, including 2,4-D which was reportedly used at the subject property from approximately 1980 to 1991. None of the composite soil samples analyzed showed detectable levels of these compounds. Copies of the analytical data sheets for the soil samples and a map showing the sample locations are included in Appendix A.

Soil samples, however, were not analyzed for potential degradation products of 2,4-D, (e.g., 2,4-dichlorophenol) or for dioxins, which have been found at measurable levels as a contaminant in some manufactured forms of 2,4-D (i.e., at concentrations ranging from 5 ug/kg to 500 ug/kg). These compounds can be toxic to humans and other species. Recent studies conducted on the environmental fate of 2,4-D, indicate that the average half-life of 2,4-D ranges from approximately 1 to 7 days and that typical 2,4-D residues (i.e., degradation products) are not persistent in soil, water or vegetation (Extension Toxicology Network, 1996). Dioxins, however, if present, are not readily degradable. Therefore, although likely limited in concentration, some toxic byproducts of 2,4-D could still be present in shallow soil on the subject property.

5.2 Mercury Soil Sampling

In March 2000, Advanced Biological Testing, Inc. (ABT) sampled soil at 8 locations in the northeastern portion of the property for mercury and methyl-mercury. This northeastern section of the property has received dredge spoils resulting from historic dredging of Bel Marin Keys.

Results of the sampling indicate mercury concentrations range from 0.181 to 0.496 milligrams per kilogram ("mg/kg"), and methyl-mercury concentrations range from 0.001 to 0.0325 mg/kg in shallow soils. Mercury and methyl-mercury concentrations detected in these samples are below their U.S. Environmental Protection Agency ("EPA") Region 9 Residential Preliminary Remediation Goals ("PRGs") of 23 mg/kg and 6.1 mg/kg, respectively (U.S. EPA, 1999). The Residential PRGs are human health-risk based goals that are calculated using standard EPA human health exposure assumptions for residential use. These goals are based on a target incremental cancer risk of one in a million and a hazard index of one, whichever is more stringent. Therefore, concentrations of mercury and methyl-mercury detected in these soil samples are not likely to create a significant risk to human health. These results are being reviewed by the U.S. Corps of Engineers and environmental regulatory agencies in association with the potential conversion of the subject property into a wetland. A copy of the report entitled *Results of Soil and Sediment Testing for Total Mercury and Methyl-Mercury at the Bel Marin Keys Disposal Area* is included in Appendix B.

6.0 REGULATORY AGENCY RECORDS REVIEW

6.1 Environmental Data Resources Report

EKI contracted with Environmental Data Resources, Inc. ("EDR") to provide a computer search of various federal, state, and local agency databases in an attempt to identify reported chemical release sites and use sites within approximately one mile of the subject property. The EDR report, dated 9 March 2000, is included in Appendix C. The list of databases searched by EDR, including a list of findings, is shown in the Executive Summary section of the EDR report.

According to the EDR report, the subject property is not listed as a reported chemical use or release site. No agency records identify the former above ground tanks located at the base of Headquarters Hill.

EDR identified five chemical release sites and three chemical use sites located within approximately three-quarters of a mile of the boundary of the subject property. The reported chemical release sites are listed below:

- Hamilton Army Airfield
- Omni-Glow Corporation (20-C Pimentel Court)
- Marin Humane Society (171 Bel Marin Keys Boulevard)
- Tile West (11 Hamilton Drive)
- Novato Fire Station No. 2 (450 Atherton Avenue)

The Novato Fire Station No. 2 (450 Atherton Avenue) is apparently mislocated on the map provided with the EDR report, and will not be considered further in this report.

The three reported chemical use sites located within three-quarters of a mile from the subject property are listed below:

- Cellegy Pharmaceuticals, Inc. (371 Bel Marin Keys)
- Rainbow Press Incorporated (14 Commercial Boulevard, Suite 107)
- Marin Products Company, Inc. (55 Frosty Lane)

EKI submitted requests to the following environmental regulatory agencies to review available file information on the above-listed sites:

- California Department of Toxic Substances Control ("DTSC");
- California Regional Water Quality Control Board ("RWQCB");
- Marin County Environmental Health Department; and
- City of Novato Fire Department.

A brief discussion of the reported chemical use and release sites based on regulatory agency information reviewed by EKI, and potential for impacts to the subject property is presented below.

6.2 Omni-Glow Corporation (20-C Pimentel Court)

According to the EDR report, the Omni-Glow site is located approximately one-half mile west of the Headquarters Hill area of the subject property. Omni-Glow manufactured "activated" glow sticks. Chemicals used onsite included petroleum distillates, phthalates, toluene, salicylic acid, and oxalate. Public documents indicate preparation of a work plan to characterize soil for a sump closure at the Omni-Glow facility. Omni-Glow entered into a Voluntary Cleanup Agreement with the Department of Toxic Substances Control in 1996 (Docket No. HSA-95/96-058). No information was available in public files following this date. Given the distance of Omni-Glow from the subject property and the limited permeability of the sediments in the area, potential chemical releases from the Omni-Glow site are unlikely to impact soil or groundwater on the subject property.

6.3 Marin Humane Society (171 Bel Marin Keys Boulevard)

The Marin Humane Society site is located approximately three-quarters of a mile from the western end of the subject property. In 1991, a 550-gallon underground gasoline fuel tank was removed from the Humane Society. Approximately 20 cubic yards of TPH impacted soil was excavated and removed. TPH as gasoline, BTEX, and MTBE were detected in groundwater at the underground storage tank ("UST") site. According to a Case Closure Site Summary Form prepared by the RWQCB, dated 15 October 1997, the RWQCB indicated that "the GW pollution plume is limited in areal extent with concentrations of TPH-g, toluene, ethylbenzene, and xylenes dropping substantially 15 feet from the former UST location and with benzene and MTBE concentrations at levels low enough not to represent an environmental or human health threat." Given this information, the fuel release at the Humane Society site is not expected to adversely impact the subject property.

6.4 Tile West (11 Hamilton Drive)

The Tile West site is located approximately three-quarters of a mile from the subject property. In 1992, soil containing low concentrations of toluene and lead was discovered during the removal of one gasoline UST and one diesel fuel UST. The impacted soil was excavated and removed off-site. Low concentrations of toluene and lead were detected in groundwater. According to a Case Closure letter prepared by the RWQCB, dated 19 August 1993, the Tile West fuel release case is closed due to removal of impacted soil and low concentrations of lead and toluene in groundwater. Impacts to the subject property from the Tile West release are not expected.

6.5 Hamilton Army Airfield

Chemical releases to soil and groundwater have occurred on the Hamilton Army Airfield ("HAA") site, which is located adjacent to and south of the subject property (Figure 2). Chemical releases identified at HAA primarily consist of petroleum hydrocarbon compounds. Volatile organic compounds ("VOCs"), semi-volatile organic compounds, polychlorinated biphenyls, and methyl

tertiary butyl ether ("MTBE") have also been detected in some areas. The HAA site is being investigated and remediated by the Army under the oversight of the DTSC in conjunction with the RWQCB, and the U.S. EPA. The remedial investigation of HAA is generally complete and a risk assessment, which identifies screening levels for cleanup has been submitted to the regulatory agencies for review (verbal communication with Lance McMann the current DTSC project officer for HAA). The northern portion of HAA, which is located adjacent to the subject property is proposed for restoration as a wetland (California State Coastal Conservancy and U.S. Army Corps of Engineers, 1998).

Eight potential chemical release sites have been identified on the HAA site near (i.e., within 2000 feet) and potentially upgradient of the subject property. Discussions regarding results of investigations conducted at each of these sites and conclusions regarding potential impacts to the subject property from these sites are presented in Sections 6.5.1 through 6.5.8 below. Information regarding a groundwater plume which extends onto the BRAC portion of HAA from a gas station located at adjacent Navy property housing is also presented in Section 6.5.9. This plume is being investigated by the Navy under the oversight of the RWQCB.

6.5.1 JP-4 Pipeline

A buried pipeline that originally carried aviation gasoline and later JP-4 liquid fuel extended along the northern boundary of HAA (see Figure 2). This line split into three parallel supply lines in the vicinity of the hangars). The onshore and offshore portions of this fuel line were evaluated separately and are discussed below.

Onshore Fuel Line

The onshore fuel line extended from the shoreline inland to the fueling facilities near the hangars. This pipeline runs adjacent to (i.e., approximately 175 feet from) the southern boundary of the subject property and was removed in 1975. Based on a subsurface investigation performed by Engineering Science ("ES") in 1993, low concentrations (i.e., less than one part per million) of VOCs (i.e., toluene and xylenes) were detected in soil along the Perimeter Road section of the onshore fuel line. Petroleum hydrocarbons were detected in soil at concentrations greater than 100 milligrams per kilogram. According to ES, lack of detectable concentrations of TPH in soil gas samples at the fuel line depth and the good condition of pipeline indicated that any contamination related to the fuel line was likely to be a result of spills at former fueling stations rather than fuel line leaks.

In 1994, the IT Corporation ("ITC") performed subsequent soil sampling along the fuel pipeline. Based on the results of analyses, the soil contamination was primarily located along the hangar fuel lines. With one exception, detectable levels of contamination did not extend beyond 20 lateral feet from the pipeline. Due to the low hydraulic conductivity of the soil the total extent of the vertical contaminant migration has been limited to 10 feet below ground surface ("bgs"). No significant groundwater impacts have been identified in association with chemical releases along the JP-4 fuel line (verbal communication with Susan Gladstone of the RWQCB).

Based upon these data and information obtained from the RWQCB, impacts to soil and groundwater on the subject property from releases at the on-shore fuel line are unlikely.

Offshore Fuel Line

The offshore fuel line extended from the perimeter ditch to the offshore levee and is located approximately 4000 feet south of the southern shoreline boundary of the subject property (Figure 2). A portion of this line was removed in 1998. The segment of the fuel line that extended out into San Pablo Bay was not removed.

According to ITC 1997 and 1998 sampling results, TPH contamination related to releases from the offshore fuel line was limited to a 12-foot lateral extent and less than a 7.5-foot vertical extent bgs. No significant groundwater impacts have been identified in association with chemical releases along the JP-4 fuel line (verbal communication with Susan Gladstone of the RWQCB).

Based upon these data and information obtained from the RWQCB, impacts to soil and groundwater on the subject property from releases at the on-shore fuel line are unlikely.

<u>6.5.2 Leaking Underground or Above Ground Storage Tanks</u>

A number of above ground ("AST") and below ground ("UST") storage tanks were located throughout the HAA. Substances contained in these tanks included fuel oil, diesel fuel, solvents, pesticides, waste oil, grease, and other substances. Releases from the ASTs and USTs resulted in soil and groundwater contamination by petroleum hydrocarbons and dichloromethane (methylene chloride). The U.S. Army Corps of Engineers' (COE) 1989 *Final Report Hamilton AFB, Storage Tank Removal Project* documented the investigation associated with contamination of eleven areas of HAA. As of 1989, 64 USTs were removed from HAA and 25,000 cubic yards of soil were excavated southwest of the runway.

According to ITC, due to the low hydraulic conductivity nature of the fill soil and the bay mud that underlies the HAA, any spills and leakage associated with the UST and AST sites has been for the most part remediated or contained. The lateral extent of soil contamination that ITC measured at any tank site in 1998 was 50 feet and the vertical extent was 2.5 to 15 feet. No significant groundwater impacts have been identified in association with chemical releases associated with any of these tanks (verbal communication with Susan Gladstone of the RWQCB). Only three of the current or former UST and AST sites associated with HAA are in close proximity to the subject property. These tank sites were all used to store diesel fuel and are described below.

Building 26

Building 26 is located approximately 180 feet south of the subject property. According to the 1996 Environmental Impact Statement ("EIS") prepared by the COE, there was documented evidence in 1996 of a possible release from a fuel UST at Building 26 (see Figure 2). The

majority of chemical impacted soil that was identified in association with the TPH release at Building 26 is limited to within 20 feet of the building. Therefore chemical impacts to the subject property resulting from releases from this tank are unlikely.

Building 20

Building 20 is located approximately 170 feet south of the subject property. ITC detected petroleum hydrocarbons and lead in a groundwater sample collected from the excavation pit following removal of a UST located near Building 20 (see Figure 2), situated approximately 30 feet southeast of the northern perimeter onshore fuel line. Specific information regarding the extent of impacted groundwater at this location was not found, however, Susan Gladstone of the RWQB indicated that no significant groundwater impacts (i.e., migrating plumes) have been identified in association with chemical releases associated with tanks at HAA. Therefore, chemical impacts to the subject property resulting from releases from this tank are unlikely.

Building 15

Building 20 is located approximately 550 feet south of the subject property. According to the 1996 EIS prepared by the COE, one empty AST with a 250-gallon capacity was noted in the vicinity of Building 15 (see Figure 2). There was no visual evidence of releases from the tank reported by the COE.

<u>6.5.3 Landfill 26</u>

The following information regarding Landfill 26 ("LF26") is based on a review of both the 1996 EIS prepared by the COE and a Preliminary Assessment/ Site Investigation Review performed on the HAA site by Ecology and Environment, Inc. ("E&E") in 1991. LF26 is located at the north end of the HAA site between Ammo Hill and Reservoir Hill approximately 1,700 feet from the subject property (see Figure 2). LF26 currently comprises an area of 23 acres and has a total fill volume of approximately 233,000 cubic yards. The primary contaminants associated with LF26 are petroleum-related products and metals. Secondary contaminants found in LF26 include semi-volatile organic compounds, chlorinated pesticides, and polychlorinated biphenyls ("PCBs").

Petroleum hydrocarbons and their degradation products and VOCs were found in the groundwater below LF26. Chlorobenzene was detected in four wells at concentrations up to 230 micrograms per liter ("µg/L"), 1,4-dichlorobenzene was detected in 5 wells at concentrations up to 34 µg/L, and trans-1,2-dichloroethene was detected in one well at 7.4 µg/L. Five dissolved metals were also detected in the groundwater below LF26 at elevated levels. Lead was detected above its EPA maximum contaminant level ("MCL"); and arsenic, boron, barium, and iron were all detected at more than three times their respective background levels.

According to the E&E report, an aquitard impedes vertical migration of contaminants under most of LF 26, but it tapers off resulting in interconnection between the shallow unconfined zone and lower aquifers. The groundwater contamination is reported to be generally limited to the shallow unconfined zone beneath LF26.

Surface drainage from LF26 either runs into a series of unlined ditches and buried culverts that feed the HAA peripheral drainage system or flows into Pacheco Creek. Southeast of LF26, trans-1,2-dichloroethene and trichloroethene ("TCE") were detected in surface water, but have not been detected anywhere else in the vicinity of LF26.

LF26 was capped in 1996 and a groundwater extraction and treatment system was installed in areas surrounding the landfill as part of the remediation design. The groundwater extraction system was discontinued because it could not draw enough water. No definitive groundwater plume has been identified in association with it. Sporadically elevated concentrations of chemicals of concern have been encountered in the vicinity of LF26, but no consistently high concentrations of these compounds are found.

Based upon these data, impacts to soil and groundwater on the subject property from releases at LF26 are unlikely.

6.5.4 Airfield

According to the 1996 EIS prepared by the COE, radioactive waste was buried in culverts at northeast corner of the airfield in the 1950's and 1960's (see Figure 2) located approximately 2,200 feet from the subject property. In 1988, the culverts were recovered by Chem-Nuclear under contract to the U.S. Army. Exhumation generated 13 drums of low-level radioactive waste that were disposed of at a licensed burial site. The assessment of the site concluded no further action was required (EIS, 1996).

According to the EIS, in 1989 an abandoned 55-gallon drum containing PCB at levels of 2,000 parts per billion was discovered in the northern corner of the airfield (see Figure 2). The drum was disposed of in 1990. Soil samples near the drum were uncontaminated.

Based upon these data, impacts to soil and groundwater on the subject property from releases at the Airfield are unlikely.

6.5.5 Perimeter Ditch

The perimeter ditch receives runoff from the entire airfield and discharges into San Pablo Bay. It is located adjacent to (i.e., set back approximately 25 to 50 feet from) the south central and southwestern boundary of the subject property. The portion of the ditch abutting the south central portion of the property is concrete lined, while the portion abutting the southwestern portion of the subject property is unlined. According to the 1996 EIS prepared by the COE, the perimeter ditch was reportedly dredged in 1992, in the fall/winter of 1993/1994, and in 1995. An estimated 200 cubic yards of material was deposited in spoil stockpiles along the perimeter

drainage ditch. Four samples out of the 34 taken in 1998 along the length of the perimeter drainage ditch had detectable levels of polynuclear aromatic hydrocarbons ("PNAs"). Site investigations by ITC in 1998 revealed potential contamination related to metal concentrations above baseline values and pesticides (DDT).

Transport of impacted sediments from the perimeter ditch onto the subject property are unlikely, even in the event of an overflow, due to the presence of a levee which separates this ditch from the subject property. No information regarding potential impacts to groundwater from this ditch were identified.

6.5.6 Petroleum. Oil. and Lubricant ("POL") Area

The petroleum, oil, and lubricant ("POL") area is located southeast of LF26 and approximately 1,500 feet south of the subject property. According to the 1996 EIS prepared by the COE, the POL area contained a variety of fuel storage facilities, including twenty 25,000-gallon USTs used to store Jet fuel and one 750-gallon UST with undetermined contents. In addition there was one 840,000-gallon AST (AST2) and one 25,000-gallon AST used to store JP-4 fuel and the associated fuel lines and pumping systems. All 26 USTs and AST2 were removed by ITC in 1986. The remaining AST and fuel lines were removed in 1990 by ITC.

According to the 1996 EIS prepared by the COE, soil, groundwater, and bedrock in the POL area is impacted by TPH. To date, remediation of this site has consisted of soil and rock removal. While the remediation was partially successful, residual non-lead fuel contamination remains both in the groundwater and unsaturated rock below AST2 and the removed fuel lines. Approximately 15,000 cubic yards of soil contaminated at levels above 100 mg/kg TPH remain in the POL area. Groundwater wells have been installed around the POL area. Data from these wells indicate that the extent of groundwater impact by the POL area does not likely extend onto the subject property and that the plume appears stable (personal communication with Jim Ponton, RWQCB). Therefore, chemical impacts to the subject property resulting from releases from the POL area are unlikely.

6.5.7 Revetment Area

The Revetment Area is located approximately 200 feet south of the subject property and consists of 28 turnouts formerly used for aircraft parking and maintenance, one pad, and revetment. This area was also used for jet engine testing. Fuel and oils were reportedly spilled or dumped onto the ground in the revetment area.

According to the 1996 EIS prepared by the COE, three groundwater monitoring wells, three test pits, and 16 boring locations were installed during 1994. The results of soil analyses indicated that TPH contamination was variable. Soil at approximately one-half of the revetments had TPH concentrations greater than 50 mg/kg, some had TPH concentrations greater than 100 mg/kg, and others showed no significant TPH contamination. The EIS report also indicates some revetment

soils were impacted with semi-volatile organic compounds, as well as low levels of toluene and lead. No significant groundwater contamination was reported.

Based upon these data, impacts to soil and groundwater on the subject property from releases at Revetment Area are unlikely.

6.5.8 North Antenna Field ("NAF")

The North Antenna Field ("NAF") is currently state-owned land, and used by the Novato Police Department as a firing range. The North Antenna Field is located adjacent to the southeastern portion of the subject property (Figure 2). A levee extends along the boundary of the subject property and the NAF. According to Susan Gladstone at the RWQCB, the NAF is currently under investigation by the Army. An initial site characterization report prepared by ITC was submitted in 1999 which reported soil contamination issues associated with the following:

- former burn pit areas (dioxins, furans, and VOCs);
- abandoned automobiles (metals and petroleum hydrocarbons);
- antenna field support facilities septic system (VOCs);
- above ground storage tanks (petroleum hydrocarbons); and
- pistol, rifle and skeet ranges (lead and polynuclear aromatic hydrocarbons).

A *Final Removal Action Completion Report for the Ammunition Burn Pit and Rifle Range Road Burn Pit*, was submitted to the RWQCB in January 2000, and describes removal of residual debris and contaminated soil associated with these two areas. The status of other issues remains under investigation.

One disturbed area of the ground surface, identified in aerial photographs and which may be a former burn pit, is located near the boundary with the subject property (see Figure 2). Impacts to soil or groundwater on the subject property from this area are unknown; however, no significant groundwater issues associated with the NAF have been reported (Susan Gladstone, RWQCB) and identified soil impacts are not likely to extend onto the subject property because a levee separates the NAF from the subject property (CSW, 1996).

6.5.9 Navy Property Housing

Navy Property Housing exists southwest of LF26 approximately 5000 feet southwest of the subject property. Information obtained from Susan Gladstone at the RWQCB indicates that methyl-tertiary butyl ether ("MTBE") plume originates from a gasoline service station located in this area. This plume is being investigated by the Navy under the oversight of the RWQCB. The plume is migrating in a northeasterly direction and significant migration of this plume has occurred, however, it does not currently extend north or east of Ammo Hill, which is located approximately 1,500 feet south of the subject property. Therefore, this plume is not currently impacting groundwater beneath the subject property. However, if this plume is not remediated and additional significant migration of this plume occurs, it could migrate onto the subject

property in the future. Discussions with RWQCB staff indicate that continued monitoring and potential remediation of this plume are likely to be required. A tentative RWQCB order was recently issued for this area (oral communication with Susan Gladstone and Jim Ponton of the RWQCB).

6.6 Other Chemical Use Sites

Given the distance of the remaining reported chemical use sites (Marin Products Company, Inc., Cellegy Pharmaceuticals, Inc., and Rainbow Press Incorporated) to the subject property (approximately three-quarters of a mile), impacts to the subject property from chemical releases at these sites would not be expected to have a significant adverse impact on the subject property.

7.0 SUMMARY AND CONCLUSIONS

7.1 Land Use and Environmental Investigations on the Subject Property

- The subject property has been in agricultural use (i.e., oat hay and tomato farming) for many decades. The northeastern portion of the subject property has also been used for placement of dredge spoils from Bel Marin Keys.

7.1.1 Chemical Use

- Pesticides and herbicides were likely applied to surface soil on the subject property. However, results of soil sampling conducted across the central and western portions of the subject property in 1989 did not identify the presence of detectable concentrations of organochlorine pesticides, herbicides, PCBs, or petroleum hydrocarbons in shallow soil samples, including the herbicide 2,4-D which is reported to have been used on the subject property in the 1980's. Therefore, widespread impacts to soil on the subject property of these compounds are unlikely.

- No testing of soil on the subject property was conducted, however, for potentially toxic degradation byproducts of 2,4-D (e.g., 2,4-dichlorophenol) or potential contaminants (i.e., dioxins) found in some manufactured forms of 2,4-D (Industry Task Force, 1999). Therefore, although likely limited in concentration due to their susceptibility to degradation and/or limited initial concentrations, these byproducts could still be present in shallow soil on the subject property.

- No sampling for potential chemicals of concern has been conducted near the sheds identified on the subject property. These sheds may have been used to store pesticides and herbicides as well as petroleum hydrocarbons (i.e., fuels and oils) and solvents (i.e., degreasing solvents), which may have been used in association with farm equipment maintenance and repair. Therefore, if soil in the vicinity of these sheds contains residual concentrations of petroleum hydrocarbons, solvents, and or agricultural chemicals it would not have been detected during the prior soil sampling conducted on the subject property.

7.1.2 Fuel Storage Tanks

- A previous environmental assessment conducted by Blymyer indicated the presence of two above ground fuel tanks and dispenser off the southern base of Headquarters Hill. At the time of the current walk through, the only remaining remnant of this former fueling area was the concrete pad. No visible signs of fuel releases (i.e., staining or odors) were observed during the walk through. However, no tank closure documentation was identified at the local agencies. Additionally, no soil or groundwater sampling has been conducted at this location

- One above ground storage tank was also observed at the southern base of Headquarters Hill, near a mobile home residence. This tank was approximately 3 feet in diameter and 4 feet in

length and was situated on wooden blocks. The tank was not in use and appeared as if it had been stored at this location for some time. Tapping of the sides of the tank resulted in a hollow sound, indicating the tank was empty or almost empty. No visible signs of fuel releases were observed at this location. However, no soil or groundwater sampling has been conducted at this location.

7.1.3 Debris Piles

- The 1994 Miller Pacific Engineer Group Phase I report indicated the presence of a refuse pile located in the northeastern corner of the subject property and a pile of tires in the eastern portion of the subject property. Both piles were located on the bay side of the levee. Due to access constraints at the time of EKI's walk-through of the subject property, these refuse piles were not observed by EKI. No obvious hazardous materials were reported.

7.1.4 Mercury Sampling of Dredge Spoils

- In March 2000, sampling for mercury and methyl-mercury was conducted. Samples were collected from dredge spoils located in the northeastern portion of the property and which originated from the Bel Marin Keys. Results of the sampling indicate mercury concentrations range from 0.181 to 0.496 milligrams per kilogram ("mg/kg"), and methyl-mercury concentrations range from 0.001 to 0.0325 mg/kg in shallow soils in the northeastern portion of the subject property. Mercury and methyl-mercury concentrations detected in these samples are below their U.S EPA Region 9 Residential Preliminary Remediation Goals ("PRGs") of 23 mg/kg and 6.1 mg/kg, respectively (U.S. EPA, 1999). Therefore, concentrations of mercury and methyl-mercury detected in these soil samples are not likely to create a significant risk to human health. These results are being reviewed by the U.S. Corps of Engineers and environmental regulatory agencies in association with the potential conversion of the subject property into a wetland.

7.2 Potential Environmental Impacts from Nearby Sites

7.2.1 Hamilton Army Airfield

- Chemical releases to soil and groundwater have occurred on the Hamilton Army Airfield ("HAA") site, which is located adjacent to and south of the subject property. Chemical releases identified at HAA primarily consist of petroleum hydrocarbon compounds. Volatile organic compounds ("VOCs"), semi-volatile organic compounds, polynuclear aromatic hydrocarbons, and MTBE have also been detected in some areas. The HAA site is being investigated and remediated by the Army under the oversight of the DTSC in conjunction with the RWQCB, and the U.S. EPA. The remedial investigation of HAA is generally complete and a risk assessment, which identifies screening levels for cleanup has been submitted to the regulatory agencies for review (verbal communication with Lance McMann the current DTSC project officer for HAA). The northern portion of HAA, which is located

adjacent to the subject property is proposed for restoration as a wetland (California State Coastal Conservancy and U.S. Army Corps of Engineers, 1998).

- Eight potential chemical release sites have been identified on the HAA site near (i.e., within 2000 feet) and potentially upgradient of the subject property. Chemicals detected in soil at these sites include petroleum hydrocarbons, volatile organic compounds, semi-volatile organic compounds, polychlorinated biphenyls, methyl tertiary butyl ether, and polynuclear aromatic hydrocarbons. Results of soil and groundwater investigations conducted at these sites indicate the following:

  (a) Chemically impacted soil is generally limited to within 50 feet of the release sites (ITC, April 1999) and has not been found to extend onto the subject property. In addition, a perimeter ditch and/or levee separate the HAA site from the subject property; therefore, migration of impacted soil from HAA onto the subject property is unlikely.

  (b) No significant groundwater chemical plumes have been identified from chemical releases on the HAA (oral communication with Susan Gladstone of the RWQCB). Therefore, impacts to groundwater on the subject property from releases at these sites are unlikely.

- In addition to these potential chemical release sites identified on HAA, a groundwater plume has been identified beneath a portion of the HAA. This plume contains MTBE, and originates at a gasoline station within the Navy housing area located south of the former runway area. It is being investigated by the Navy under the oversight of the RWQCB. The plume is migrating in a northeasterly direction and significant migration of this plume has occurred, however, it does not currently extend north or east of Ammo Hill, which is located approximately 1,500 feet south of the subject property. Therefore, this plume is not currently impacting groundwater beneath the subject property. However, if this plume is not remediated and additional significant migration of this plume occurs, it could migrate onto the subject property in the future. Discussions with RWQCB staff indicate that continued monitoring and potential remediation of this plume are likely to be required. A tentative RWQCB order was recently issued for this area (oral communication with Susan Gladstone and Jim Ponton of the RWQCB).

7.2.2 Other Nearby Sites

- A government database search identified four additional chemical release sites located generally upgradient from the subject property. However, given the distance of these release sites to the subject property, approximately three-quarters of a mile, and the nature of chemicals detected (e.g., generally petroleum products which tend to degrade readily), impacts to the subject property from these releases are not expected.

8.0 REFERENCES

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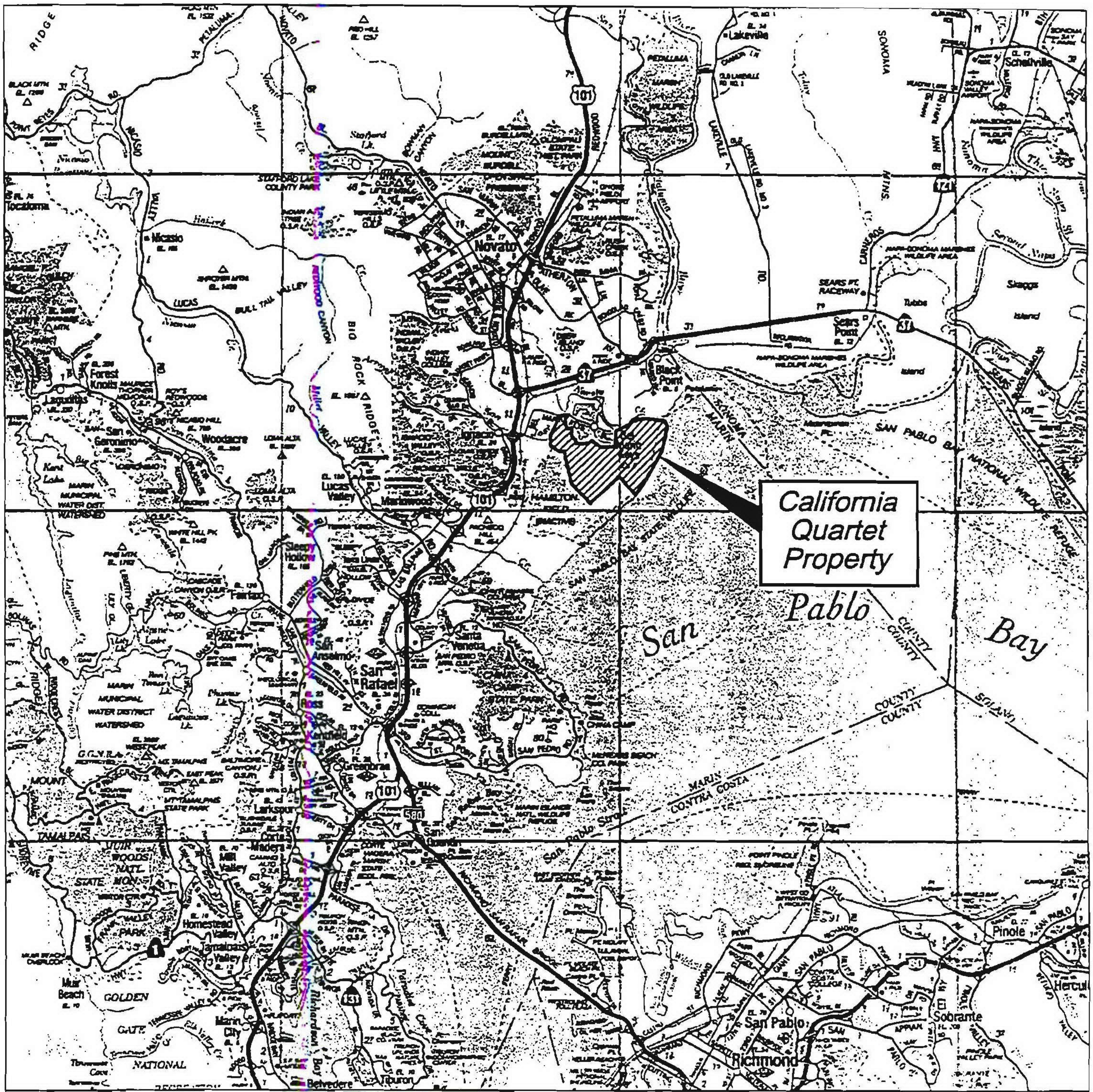
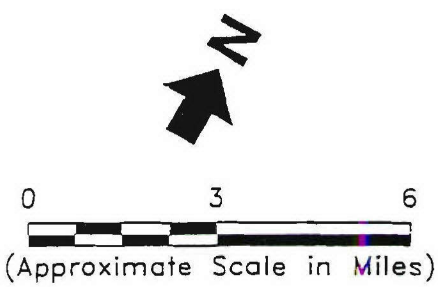


Reference: San Francisco Bay Region AAA Map, 1997.



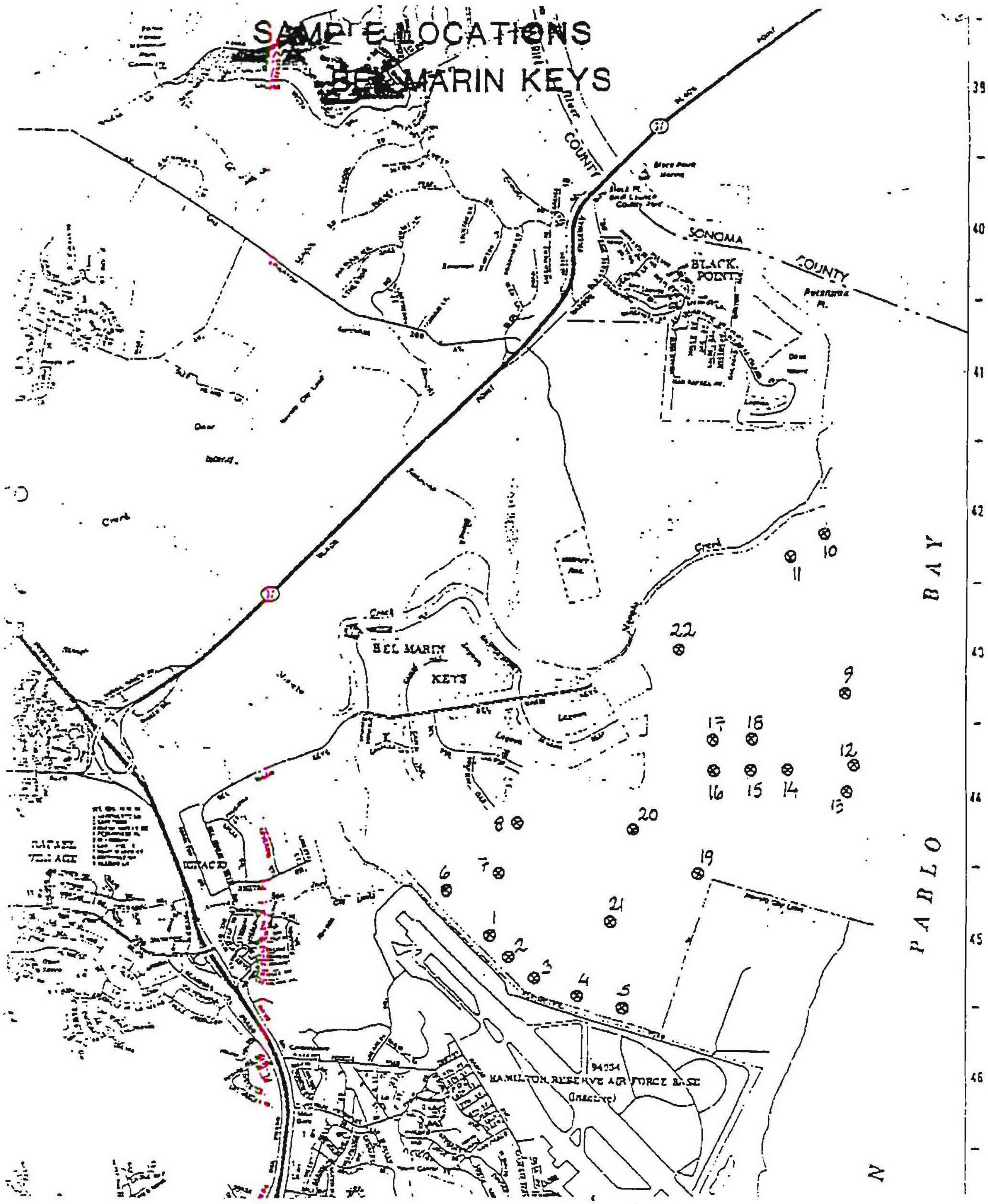
Erler & Kalinowski, Inc.

Site Location Map

California Quartet Property
Marin, CA
April 2000
EKI A00018.00
Figure 1

APPENDIX A

ANALYTICAL TEST RESULTS OF SOIL SAMPLING



Sketch received from Blymyer Engineers showing locations of soil samples obtained by Blymyer Engineers in January 1989.

MILLER PACIFIC ENGINEERING GROUP	SKETCH OF BLYMYER SAMPLING LOCATIONS BEL MARIN KEYS UNIT 5 NOVATO, CALIFORNIA	B-1
Project No. 332.02	Date 8/11/94	Approved By:
		Figure

NATIONAL ENVIRONMENTAL TESTING, INC.

NET Pacific, Inc.
435 Tesconi Circle
Santa Rosa, CA 95401
Tel: (707) 526-7200
Fax: (707) 526-9623

Formerly: ANATEC Labs, Inc.

Sue Black
Blymyer Engineers, Inc
1829 Clement Ave
Alameda, CA 94501

01-31-89
NET Pacific Log No: 5275 (1-10)
Series No: 495
Client Ref: Project# 88323

Subject: Analytical Results for 10 Soil Samples Identified as "Ignacio" Received 01-13-89.

Dear Ms. Black:

Analysis of the samples referenced above has been completed. This report is written in confirmation of results transmitted verbally on January 30 and 31, 1989. Results are presented on the following pages.

Samples were delivered to the laboratory under documented chain-of-custody. On receipt, sample custody was transferred to NET Pacific sample control personnel who subsequently documented receipt and condition of the samples and placed them in secured storage at 4°C until analysis commenced.

Samples were prepared for extractable hydrocarbons measurements by thorough mixing and subsequent extraction with methylene chloride; extraction, aided by sonication, was performed three successive times for each sample. Extracts were then combined, dried over sodium sulfate and concentrated in Kuderna-Danish apparatus. Extracts were analyzed by capillary-column gas chromatography with flame ionization detection. Preparation and analysis of samples was accompanied by similar treatment of a sample replicate, method blank and a diesel-fortified sample. Response of the chromatographic system to calibration standards prepared with commercial diesel and motor oil were compared with system response to samples for purposes of qualitative and quantitative interpretation.

Details of the analytical methodology are consistent with requirements specified in Method "II" ("Total Fuel Hydrocarbons, Medium-to-High Boiling Point Hydrocarbons") in "Guidelines for Addressing Fuel Leaks," Regional Water Quality Control Board, San Francisco Bay Region, revised 1986; the preparation procedures used are described in detail in "Sonication Extraction," Method 3550 for in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," U.S. EPA, SW-846, 3rd edition, revised 1986.

Polychlorinated biphenyls (PCBs) and organochlorine pesticides measurements were performed in accord with U.S. EPA Method 8080 in U.S. EPA, SW-846, (ibid.). Briefly, a portion of each sample as extracted three successive times with methylene chloride aided by ultrasonic agitation. The extracts were combined and reduced in volume by evaporation of solvent. Extracts were solvent-exchanged into hexane, acid cleaned, then analyzed by gas

Parameter	Reporting Limit (mg/Kg)	Descriptor, Lab No. and Results (mg/Kg) S-1 01-12-89 1245 (-20988)	S-2 01-12-89 1300 (-20989)	S-3 01-12-89 1312 (-20990)
PETROLEUM HYDROCARBONS				
Extractable,				
as Motor Oil	10	ND	ND	ND
as Diesel Fuel	10	ND	ND	ND

Parameter	Reporting Limit (mg/Kg)	Descriptor, Lab No. and Results (mg/Kg) S-4 01-12-89 1330 (-20991)	S-5 01-12-89 1345 (-20992)	S-6 01-12-89 1405 (-20993)
PETROLEUM HYDROCARBONS				
Extractable,				
as Motor Oil	10	ND	ND	ND
as Diesel Fuel	10	ND	ND	ND

Parameter	Reporting Limit (mg/Kg)	Descriptor, Lab No. and Results (mg/Kg): Comp 7,19,20,21 01-12-89 (-20994)	Comp 15,16,17,18 01-12-89 (-20995)	Comp 8,9,10,11 01-12-89 (-20996)[a]	Comp 12,13,14,22 01-12-89 (-20997)
ORGANOCHLORINE PESTICIDES					
Aldrin	0.01	ND	ND	ND	ND
alpha-BHC	0.01	ND	ND	ND	ND
beta-BHC	0.02	ND	ND	ND	ND
delta-BHC	0.01	ND	ND	ND	ND
gamma-BHC	0.02	ND	ND	ND	ND
Chlordane	0.1	ND	ND	ND	ND
4,4'-DDD	0.02	ND	ND	ND	ND
4,4'-DDE	0.02	ND	ND	ND	ND
4,4'-DDT	0.02	ND	ND	ND	ND
Dieldrin	0.01	ND	ND	ND	ND
Endosulfan I	0.01	ND	ND	ND	ND
Endosulfan II	0.01	ND	ND	ND	ND
Endosulfan sulfate	0.02	ND	ND	ND	ND
Endrin	0.01	ND	ND	ND	ND
Endrin aldehyde	0.02	ND	ND	ND	ND
Heptachlor	0.01	ND	ND	ND	ND
Heptachlor epoxide	0.01	ND	ND	ND	ND
Methoxychlor	0.02	ND	ND	ND	ND
Toxaphene	0.1	ND	ND	ND	ND
POLYCHLORINATED BIPHENYLS					
Aroclor 1016	0.1	ND	ND	ND	ND
Aroclor 1221	0.1	ND	ND	ND	ND
Aroclor 1232	0.1	ND	ND	ND	ND
Aroclor 1242	0.1	ND	ND	ND	ND
Aroclor 1248	0.1	ND	ND	ND	ND
Aroclor 1254	0.1	ND	ND	ND	ND
Aroclor 1260	0.1	ND	ND	ND	ND

[a]The reporting limit for this sample is 10 times the listed reporting limits.

Parameter	Reporting Limit (mg/Kg)	Descriptor, Lab No. and Results (mg/Kg) Comp 7,19, 20 & 21 01-12-89 (-20994)	Comp 15,16, 17 & 18 01-12-89 (-20995)	Comp 8,9, 10 & 11 01-12-89 (-20996)	Comp 12,13, 14 & 22 01-12-89 (-20997)
HERBICIDES					
2,4-D	1.0	ND	ND	ND	ND
2,4-DB	1.0	ND	ND	ND	ND
2,4,5-T	0.5	ND	ND	ND	ND
2,4,5-TP	0.5	ND	ND	ND	ND
Dalapon	6.0	ND	ND	ND	ND
Dicamba	0.5	ND	ND	ND	ND
Dichloroprop	0.8	ND	ND	ND	ND
Dinoseb	0.2	ND	ND	ND	ND
MCPA	200	ND	ND	ND	ND
MCPP	200	ND	ND	ND	ND

APPENDIX B

RESULTS OF SOIL AND SEDIMENT TESTING FOR TOTAL MERCURY AND METHYL-MERCURY AT THE BEL MARIN KEYS DISPOSAL AREA

RESULTS OF SOIL AND SEDIMENT TESTING FOR TOTAL MERCURY AND METHYL-MERCURY AT THE BEL MARIN KEYS DISPOSAL AREA

Prepared for

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Prepared by:

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April 25, 2000

1.0 INTRODUCTION

The Bel Marin Keys Homeowners Association is proposing to dredge the Bel Marin Keys to historic depths in a maintenance dredging program. The Lagoon has been dredged historically and the sedimentary material placed at an adjacent upland site to dry (Figure 1). This site has been utilized for agricultural purposes since the last deposition of dredge material (early 1990's). Based upon the results of several recent studies conducted on sediments from the Lagoon, there is some concern regarding sedimentary levels of mercury (0.4 to 0.6 mg/kg dry weight). While the source of the mercury has not been defined, it is possible that natural sources in the Novato Creek watershed may be implicated. As part of a risk assessment for the upland disposal of sediment with moderate mercury contamination a preliminary research study is proposed.

The proposed study was designed to examine the existing historic disposal area (Figure 1) and determine levels of total mercury and methylmercury at eight sampling locations on the parcel and four stations in Novato Creek. Methylmercury is considered the bioactive compound causing toxicity and is implicated in bioaccumulation processes. It was assumed that the sediments and contaminants previously deposited into the disposal site are similar to those occurring in the Lagoon at the present time.

The proposed Study Plan was for a limited testing of sediments primarily from the historic disposal site that is proposed for reuse as part of the current dredging program. The analytical testing requirements are based on the Inland Testing Manual (ACOE/U.S.EPA 1998). This preliminary study was designed to evaluate the existing total mercury and methylmercury conditions at the historic disposal site and reference locations using soil samples split into horizontal segments. A total of eight core samples were be taken from the eight stations identified on Figure 1. Each core was taken to 18" in depth. Each sample was divided into a top or surface sample (0"-6"), a mid-depth sample (6"-12" deep) and a bottom sample (12" - 18" deep) for analysis.

Each collected sample was placed immediately in a cleaned glass jar, labeled with a sample identification number, and placed in a cooler for transport to the analytical laboratory. Each sample was analyzed for total mercury, and methylmercury. The detection limits achieved was 0.02 µg/kg dry weight for total mercury and 1 µg/kg for methyl mercury. The percentage of methylated to total mercury was determined for each sample. In addition to

the samples from the disposal parcel, two additional stations were located outside the levee adjacent to the historic disposal site and represent background conditions in the lower portion of Novato Creek. To assess sedimentary conditions upstream of the proposed dredge site, two stations were located upstream where Novato Creek passes under Highway 37. Positioning was by handheld GPS.

The sample collection was carried out by Advanced Biological Testing Inc. in Rohnert Park, California. The analytical chemistry was carried out by CRG Marine Laboratory in Terminal Island, California.

Quality assurance procedures to be used for sediment testing are consistent with methods described in the U.S.EPA/ACOE (1998). The methods employed in this sediment testing program are detailed in standard guides and procedures maintained in the analytical laboratory.

QA/QC procedures will include the analysis of procedural blanks and duplicates. The analysis of total mercury was by method EPA 6020 (ICP/MS). The analysis of methyl mercury was by ICP/MS. Daily logs of instrument performance are maintained including initial and continuing calibration verification.

2.0 RESULTS

The positioning and geological characteristics at the twelve test sites is presented in Table 1. The results of the sampling and testing program are presented in Tables 2 and 3.

Based upon the coring logs the material in the disposal area was dominated by relatively dry clayey/silty soil in the top six inches. Substantial grass and root growth was evident in the top six inches and was not noted at any significant level in the deeper sediments. The deeper sediments also were more hydrated than those on the surface with some free water collecting at the bottom of the hole (18"). It appeared that the water table is within one foot of the current soil surface elevation.

The results of the analytical testing show generally lower levels of total mercury in all of the three depth levels within the dredge disposal area than in the samples previously collected from the Lagoon (0.4 - 0.5 mg/Kg). The surface sediments had the highest average concentration of total mercury at 0.328 mg/kg. The 6" to 12" level and the 12"-18" had similar but lower concentrations of 0.268 mg/kg and 0.270 mg/kg respectively. The percentage of methyl mercury decreased with depth from 2.86% (0.009 mg/kg) in the surface sediments to 1.76% (0.004 mg/kg) in the mid-section, then increased again to 2.80% (0.002 mg/kg) in the bottom sediments.

The four samples taken from Novato Creek had higher total mercury concentrations in all three horizons than in the dredge disposal area. In the near reference stations (R-1 and R-2), the surface average was 0.362 mg/kg, with the mid-level at 0.418 mg/kg and the bottom at 0.371 mg/kg. In the upstream reference stations (R-3 and R-4) the surface was 0.406 mg/kg, the mid-level was 0.43 mg/kg and the bottom was 0.422 mg/kg.

Methyl mercury concentrations in the reference stations were slightly higher than in the dredge disposal area. The percentage of methyl mercury in the surface samples from the near reference stations was 3.29% (0.012 mg/kg). The mid-depth level had 3.71% (0.016 mg/kg) methyl mercury while the bottom level had the highest percentage level at 6.39% (0.0.024 mg/kg). The percentage of methyl mercury in the surface samples from the upstream reference stations was 2.44% (0.010 mg/kg). The mid-depth level had 0.28% (0.001 mg/kg) methyl mercury while the bottom level had the level at 1.21% (0.005 mg/kg).

Based upon the data presented, the methylation of total mercury in the sediments that have been disposed at the upland site appears to be very low ranging from 2.69% in the surface samples to a low of 1.76% in the 6" to 12" zone. The potential for methylation appears to be slightly higher in the reference sediments from Novato Creek, particularly adjacent to the dredge disposal site.

TABLE 1

CORING LOG
Bel Marin Keys

Station	Depth	Latitude	Longitude	Sediment Description
DA-1	0-6"	38°05.429'	122°29.561'	Clays and silts, grass/roots
	6-12"			Sticky clays and silts
	12-18"			Wet clays and silts
DA-2	0-6"	38°05.302'	122°29.518'	Clays and silts, grass/roots
	6-12"			Sticky clays and silts
	12-18"			Wet clays and silts
DA-3	0-6"	38°05.107'	122°29.460'	Clays and silts, grass/roots
	6-12"			Sticky clays and silts
	12-18"			Wet clays and silts
DA-4	0-6"	38°04.921'	122°29.410'	Clays and silts, grass/roots
	6-12"			Sticky clays and silts
	12-18"			Wet clays and silts
DA-5	0-6"	38°05.009'	122°29.212'	Clays and silts, grass/roots
	6-12"			Sticky clays and silts
	12-18"			Wet clays and silts
DA-6	0-6"	38°05.131'	122°29.261'	Clays and silts, grass/roots
	6-12"			Sticky clays and silts
	12-18"			Wet clays and silts
DA-7	0-6"	38°05.283'	122°29.343'	Clays and silts, grass/roots
	6-12"			Sticky clays and silts
	12-18"			Wet clays and silts
DA-8	0-6"	38°05.476'	122°29.404'	Clays and silts, grass/roots
	6-12"			Sticky clays and silts
	12-18"			Wet clays and silts

TABLE 1 cont.

CORING LOG
Bel Marin Keys

Station	Depth	Latitude	Longitude	Sediment Description
R-1	0-6"	38°05.489'	122°29.695'	Wet clays/silts, vegetation
	6-12"			Wet clays/silts, vegetation
	12-18"			Wet clays/silts
R-2	0-6"	38°05.544'	122°29.568'	Wet clays/silts, vegetation
	6-12"			Wet clays/silts, vegetation
	12-18"			Wet clays and silts
R-3	0-6"	38°05.262'	122°32.089'	Soft unconsolidated clays/silts
	6-12"			Soft unconsolidated clays/silts
	12-18"			Sticky clays and silts
R-4	0-6"	38°05.228'	122°32.065'	Soft unconsolidated clays/silts
	6-12"			Soft unconsolidated clays/silts
	12-18"			Sticky clays and silts

Terms:
Clays and silts: fine grained sediments
Wet clays and silts: cohesive, moist
Sticky clays and silts: semi-cohesive; lower moisture than wet
Vegetation: Wetland type vegetation; Spartina sp.
Grass/Roots: Upland and commercial grasses; roots

Table 2

Comparison between Total Mercury and Methyl mercury at three depths in the sediment strata

Site	Depth 0-6 inches Hg	MeHg	%MeHg/Hg	6 to 12 inches Hg	MeHg	%MeHg/Hg	12 to 18 inches Hg	MeHg	%MeHg/Hg
DA-1	0.198	0.004	2.02%	0.096	0.0028	2.92%	0.258	0.001	0.39%
DA-2	0.277	0.0148	5.34%	0.333	0.0013	0.39%	0.231	0.0015	0.65%
DA-3	0.496	0.001	0.20%	0.224	0.0096	4.29%	0.231	0.001	0.43%
DA-4	0.181	0.0079	4.36%	0.197	0.001	0.51%	0.176	0.0061	3.47%
DA-5	0.307	0.0021	0.68%	0.221	0.0071	3.21%	0.361	0.0325	9.00%
DA-6	0.441	0.0211	4.78%	0.331	0.0089	2.69%	0.308	0.0039	1.27%
DA-7	0.356	0.0058	1.63%	0.389	0.0041	1.05%	0.3	0.001	0.33%
DA-8	0.367	0.0183	4.99%	0.356	0.003	0.84%	0.296	0.0134	4.53%
DA averages	0.328	0.009	2.86%	0.268	0.005	1.76%	0.270	0.008	2.80%
R-1	0.273	0.001	0.37%	0.456	0.0261	5.72%	0.385	0.0434	11.27%
R-2	0.451	0.0228	5.06%	0.379	0.0049	1.29%	0.357	0.004	1.12%
R-3	0.479	0.0115	2.40%	0.348	0.0013	0.37%	0.338	0.0017	0.50%
R-4	0.332	0.0083	2.50%	0.511	0.0011	0.22%	0.506	0.0085	1.68%
Ref averages	0.384	0.011	2.84%	0.424	0.008	1.97%	0.397	0.014	3.63%

Table 3

Summary of Results
Average Concentrations and Relative Percentages

Depth	0-6 in			6-12 in			12-18 in		
	Hg	MeHg	%MeHg/Hg	Hg	MeHg	%MeHg/Hg	Hg	MeHg	%MeHg/Hg
Disposal Area	0.328	0.009	2.86%	0.268	0.005	1.76%	0.270	0.008	2.80%
Near Ref	0.362	0.012	3.29%	0.418	0.016	3.71%	0.371	0.024	6.39%
Upstream Ref	0.406	0.010	2.44%	0.430	0.001	0.28%	0.422	0.005	1.21%

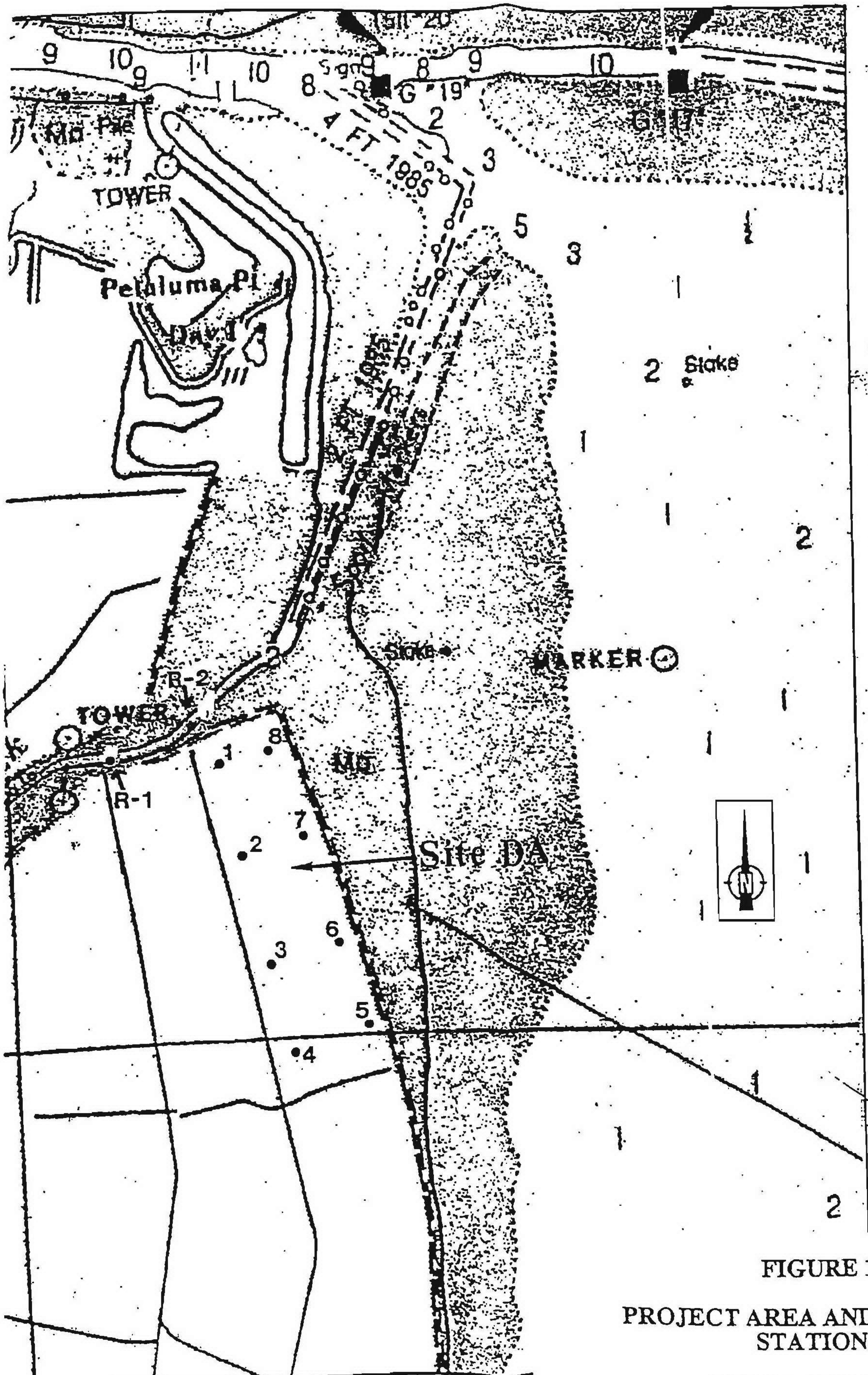
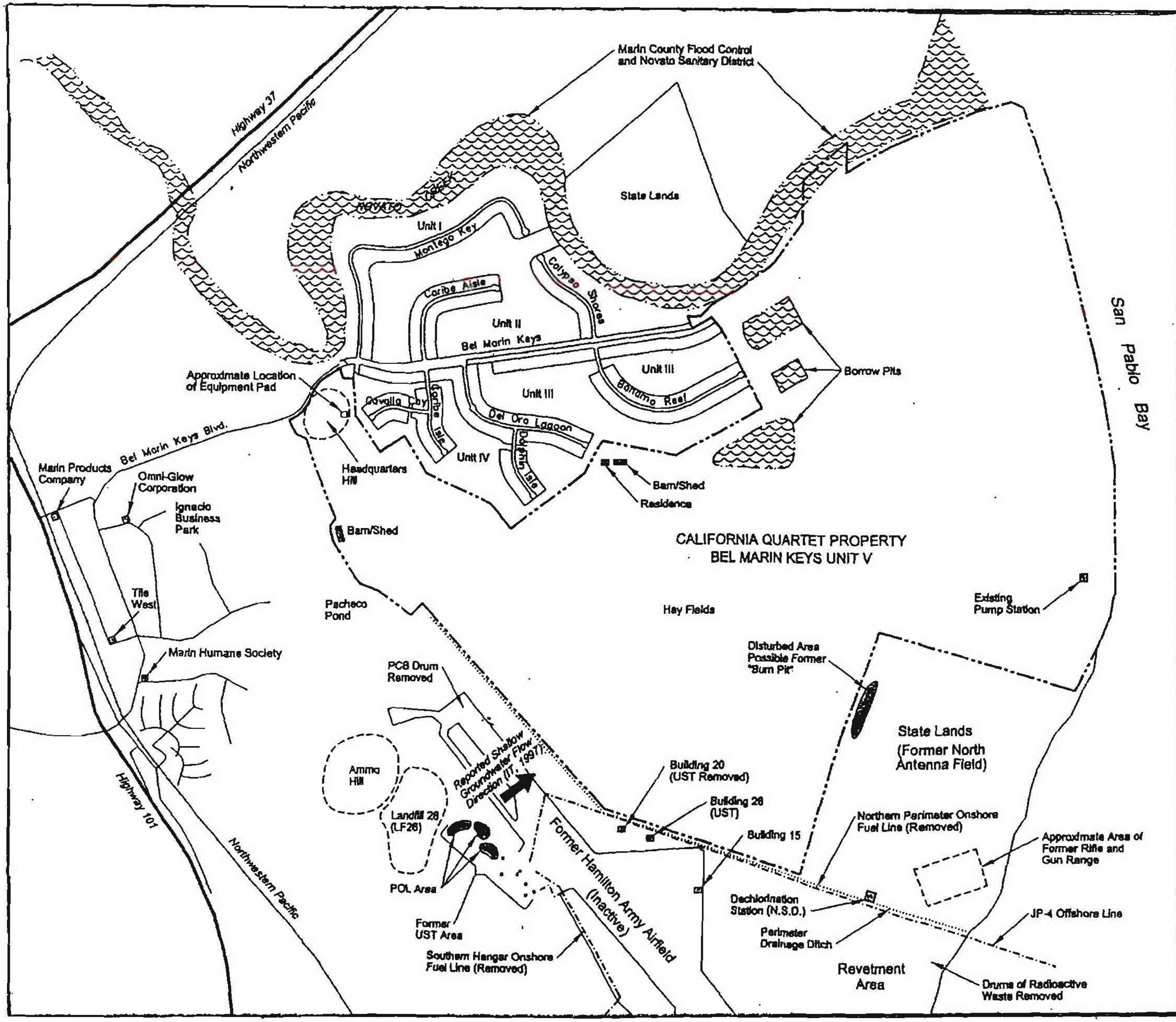


FIGURE 1

PROJECT AREA AND SAMPLING STATIONS

BEL MARIN KEYS



Erler & Kalinowski, Inc.

Site Setting

California Quartet Property
Marin County, CA
April 2000
EKI A00018.00
Figure 2

Results of Shallow Soil Investigations

Bel Marin Keys Unit V Property
Marin County, California

Prepared for:

State Coastal Conservancy
Oakland, California

Prepared by:

Erler & Kalinowski, Inc.
(EKI A00065.00)

21 March 2002

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21 March 2002

Mr. Tom Gandesbery
State Coastal Conservancy
1330 Broadway, 11th Floor
Oakland, California 94612-2530

Subject: Shallow Soil Investigations Report
Bel Marin Keys Unit V Property
Marin County, California
(EKI A00065.00)

Dear Mr. Gandesbery:

Erler & Kalinowski, Inc. ("EKI") is pleased to present this *Results of Shallow Soil Investigations* report for the Bel Marin Keys Unit V Property in Marin County, California ("subject property").

This report was completed at the request of the State Coastal Conservancy and pursuant to the recommendations presented in EKI's Phase I Preliminary Environmental Site Assessment report for the subject property, dated 5 May 2000. This report summarizes results of soil sampling performed in several areas of the subject property. The purpose of this work was to investigate potential environmental concerns associated with historical uses on and adjacent to the subject property including the use of herbicides and/or pesticides for weed and bug control, the presence/use of fuel storage tanks for vehicle filling, and the presence of a debris pile.

This report is for the sole use of the State Coastal Conservancy. Unless specifically authorized by EKI, use of or reliance on this report by any other entity is not permitted or authorized.

If you have any questions regarding the information presented in this report, please do not hesitate to call.

Very truly yours,

ERLER & KALINOWKSI, INC.

Vera H. Nelson

Meg Mendoza for

Vera H. Nelson, P.E.
Project Manger

Earl D. James, P.E.
Supervisor

Bel Marin Keys Unit V Property, Marin County, California
Results of Shallow Soil Investigations

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1.0 INTRODUCTION

This report describes the results of soil sampling performed by Erler & Kalinowski, Inc. ("EKI") at the Bel Marin Keys Unit V property located in Marin County, California (Figure 1). Work described herein was performed in accordance with EKI's proposal to the Coastal Conservancy, dated 20 July 2000.

The Bel Marin Keys Unit V property (the "subject property") is approximately 1,600 acres. The subject property has been in agricultural use for many decades. Several structures including two barns and a dilapidated residence exist on the subject property. EKI performed a Phase I environmental site assessment of the property and results of this assessment are presented in our report, dated 5 May 2000.

2.0 SCOPE OF WORK AND RATIONALE

Based on results of the Phase I environmental site assessment, soil sampling was performed at several areas across the subject property to investigate potential environmental concerns associated with historical uses on and adjacent to the subject property including the use of herbicides and/or pesticides for weed and bug control, the presence/use of fuel storage tanks for vehicle filling, and the presence of a debris pile.

The scope of work and identified areas of potential concern are described below. Soil sampling locations are shown on Figure 2. Table 1 presents a summary of samples collected and the analyses performed for each sample. Analytical test results of soil sampling are presented in Tables 2 through 8. Moisture contents were determined for the samples collected for the purpose of converting selected analytical test results to a dry weight basis and are presented in Table 9. The Department of Toxic Substances Control ("DTSC") performed an independent review of the sampling proposal and requested additional analytical testing in the area of the former above ground tanks which was incorporated into the sampling plan.

2.1 Former Above Ground Storage Tank Area

Two former above ground fuel storage tanks and fuel dispenser existed on or adjacent to the northern property boundary (Blymyer, 1989). A concrete pad and oblong concrete extension identified in our Phase I site walk-through is presumed to be the area of this former above ground tank. EKI collected two shallow soil samples (ShS-AGT-1s and ShS-AGT-2d) on the apparent downgradient side of the concrete pad and extension to investigate the potential for surface spills associated with use of the identified former

above ground tanks. These samples were collected at depths of 1.5 and 2.5 feet below ground surface ("bgs"), respectively.

Soil samples were analyzed for the following chemical constituents:

- Total Purgeable Petroleum Hydrocarbons quantified against gasoline ("TPHg") using U.S. EPA Method 8015 Mod.;
- Total Extractable Petroleum Hydrocarbons quantified against diesel ("TPHd") using U.S. EPA Method 8015 Mod. with silica gel cleanup;
- Cadmium, Chromium, Lead, Nickel, and Zinc using U.S. EPA Method 6000/7000 series;
- Polynuclear Aromatic Hydrocarbons ("PAHs") using U.S. EPA Method 8270; and
- Fuel oxygenates with MTBE and BTEX using U.S. EPA Method 8260B.

2.2 West Barn, East Barn, Crop Duster, and Drainage Ditches

Two barns are located on the subject property. One barn is located in the northwestern portion of the property ("West Barn") and one is located in the north central portion of the subject property ("East Barn"). Additionally, a 1990 aerial photograph identified the existence of an apparent crop dusting airplane on the dirt road west of the East Barn. If pesticides or herbicides were stored, mixed, or spilled on the subject property these would be likely areas of such activities. Three surface soil samples were collected near each barn (SS-East Barn-1, SS-East Barn-2, SS-East Barn-3, SS-West Barn-1, SS-West Barn-2 and SS-West Barn-3). One surface soil sample (SS-Duster-1) was collected near the area of the crop dusting airplane identified in the historic aerial photograph. Five additional surface soil samples (SS-Ditch–1 through SS-Ditch-5) were collected in the drainage ditches that transect the subject property to investigate whether these chemicals had run off with surface water drainage.

Soil samples were analyzed for the following chemical constituents:

- Organochlorine pesticides using U.S. EPA Method 8081;
- Chlorinated herbicides using U.S. EPA Method 8151; and
- Phenols using U.S. EPA Method 8270.

In addition to analyses for pesticides and herbicides, composites of samples collected near each barn and a composite of select samples collected from the drainage ditches were composited and analyzed for dioxins and furans using U.S. EPA Method 8280. These analyses were conducted because dioxins have been identified as contaminants in the manufacturing of some herbicides.

2.3 Debris Pile

One debris pile was identified in the northeastern portion of the property on the Bay side of the levee. Debris identified in the pile included bottles, cans, and rusted metals, as well as larger items such as a water heater, bicycle, and mattress springs. It appeared areas of the debris pile had been burned. A previous Phase I assessment performed by Miller Pacific Engineering Group (1994) had identified a second debris pile composed mainly of tires on the Bay side of the east-central portion of the levee. EKI's field technician identified a couple of tires in this area, but no pile. Given the lack of evidence for potential impact, no samples were collected in this area.

Four surface soil samples (SS-Debris-N-1s through SS-Debris-N-4s) collected adjacent to the debris pile were analyzed for the following:

- Metals using U.S. EPA Method 6020/7000 series;
- Semivolatile organic compounds ("SVOCs") using U.S. EPA Method 8270;
- Organochlorine pesticides using U.S. EPA Method 8081; and
- Chlorinated herbicides using U.S. EPA Method 8151.

Additionally, four soil samples (SS-Debris-N-1d through SS-Debris-N-4d) collected approximately 1 foot below the ground surface adjacent to the debris pile were analyzed for volatile organic compounds ("VOCs") using U.S. EPA Method 8260.

3.0 RESULTS OF PREVIOUS SHALLOW SOIL SAMPLING BY BLYMYER

In 1989, Blymyer Engineers, Inc. performed shallow soil sampling at 22 locations throughout the southwestern and central portions of the subject property (Blymyer, 1989). These soil sampling locations are shown on Figure 2. The soil samples were collected at approximately 12-inches below the ground surface. Composite soil samples were analyzed for total petroleum hydrocarbons ("TPH") as diesel, polychlorinated biphenyls ("PCBs"), organochlorine pesticides, and herbicides. None of the composite soil samples analyzed showed detectable levels of these compounds. Copies of the analytical data sheets for these composite soil samples are included in Appendix A.

4.0 DREDGE SPOILS SAMPLING BY ADVANCED BIOLOGICAL TESTING

In March 2000, Advanced Biological Testing, Inc. (ABT) sampled soil at 8 locations in the northeastern portion of the property for mercury and methyl-mercury. This northeastern section of the property has received dredge spoils resulting from historic dredging of Bel Marin Keys.

Results of this sampling are not discussed herein. EKI understands these results are being reviewed by the U.S. Corps of Engineers and environmental regulatory agencies in association with the potential conversion of the subject property into a wetland.

5.0 RESULTS OF SOIL INVESTIGATIONS BY EKI

5.1 Field Activities and Observations

Prior to initiating fieldwork, EKI prepared a site-specific Health & Safety Plan. On 27 July 2000, sampling activities were performed.

Soil samples were collected using a trowel and were subsequently placed in 1.5-inch diameter pre-cleaned stainless steel or brass tubes. The ends of the tubes containing the soil samples were covered with Teflon sheets and capped with plastic end caps. The sample containers were labeled and placed in an ice-filled cooler for temporary storage and transport to the analytical laboratory. Chain-of-custody documentation accompanied the samples to the laboratory. Prior to initial use and between each subsequent use, sampling equipment was cleaned with Alconox solution and triple rinsed with deionized water.

During sampling activities an organic vapor meter ("OVM") was used to screen for organic vapors from samples collected by the West Barn and the former above ground storage tank area. The OVM did not detect organic vapors in these areas, nor were petroleum hydrocarbon or other organic odors noted by the EKI field geologist during sampling activities.

5.2 Analytical Results for Soil Samples

The analytical results for soil samples are summarized below and are presented in Tables 2 through 8. Samples collected during this investigation were submitted to K-Prime Analytical laboratory in Petaluma, California, for analysis. Herbicide and dioxin analyses were subcontracted to North Coast Laboratories Ltd. and Alta Laboratories, respectively. The analytical laboratory data sheets for the soil samples are included in Appendix B.

5.2.1 Analytical Test Results for Soil Samples Collected Near the Former Above Ground Tank Area

Analytical test results indicate TPHd concentrations at 304 and 586 milligrams per kilogram ("mg/kg") detected in shallow soil near the former above ground storage tank area (see Table 2). TPHg, BTEX, and fuel oxygenates were not detected in the samples collected.

Analyses for five common metals associated with some petroleum products (cadmium, chromium, lead, nickel and zinc) are presented in Table 3. Cadmium was not detected in either of the soil samples collected. The maximum concentrations of the remaining metals analyzed were as follows: chromium at 81.7 mg/kg; lead at 271 mg/kg; nickel at 130 mg/kg; and zinc at 146 mg/kg.

PAHs were not detected in the samples collected near the former above ground tanks (see Table 4).

5.2.2 Analytical Test Results for Soil Samples Collected Near the West Barn, East Barn, Crop Duster, and Drainage Ditches

Some surface staining was identified near the West Barn where used oil filters were laying on the ground surface. Soil sample SS-West Barn-1 was collected at this location.

Analytical test results indicate the pesticide, 4,4-DDT, was detected in one soil sample collected near the East Barn at 67.7 micrograms per kilogram ("ug/kg") and one soil sample collected near the West Barn at 20.8 ug/kg. None of the other ten samples collected from these areas detected the presence of pesticides. Pesticide concentrations are presented in Table 5 on a dry weight basis. No herbicides or phenols were detected in the samples collected near the West Barn, East Barn, Crop Duster, or drainage ditches (see Tables 5 and 6).

Dioxin and furan compound concentrations from the East Barn, West Barn, and Drainage Ditch area composite samples are presented in Table 7 on a dry weight basis.

5.2.3 Analytical Test Results for Soil Samples Collected Near the Debris Pile

Analytical test results for metals from soil samples collected near the Debris Pile are presented in Table 3. Sample SS-Debris-N-1 was collected near a pile of metal cans and bottles which had evidence of being burned.

Pesticides were detected in three of the four samples collected at concentrations up to 62.3 ug/kg (4,4-DDE in sample SS-Debris-N-2s) (see Table 5).

No herbicides, SVOCs, or VOCs were detected in samples collected near the Debris Pile (see Tables 5 and 8).

6.0 CONCLUSIONS

Based on results of the investigations conducted at the subject property to date, the following conclusions are made:

- Former Above Ground Tank Area: TPHd and metals were detected in two shallow soil samples collected near the former above ground storage tank area. No TPHg, BTEX, fuel oxygenates or PAHs were detected in the samples collected from this area.

- West Barn Area: One of three soil samples collected near the West Barn detected the presence of 4,4-DDT at 20.8 ug/kg. This sample was collected near discarded waste including used oil filters. No herbicides or phenols were detected near the West Barn. The composite sample from this area submitted for dioxin analyses detected concentrations of some dioxin compounds.

- East Barn Area: One of three soil samples collected near the East Barn detected the presence of 4,4-DDT at 67.7 ug/kg. This sample was collected from within the structure. No herbicides or phenols were detected near or in the East Barn. The composite sample from this area submitted for dioxin analyses detected concentrations of some dioxin compounds.

- Crop Duster Area: No herbicides, pesticides, or phenols were detected from the sample collected near the position of a former crop dusting aircraft, as identified in the 1990 aerial photograph.

- Drainage Ditches/Field: No herbicides, pesticides, or phenols were detected in samples collected from drainage ditches across the site. The composite sample from this area submitted for dioxin analyses detected concentrations of some dioxin compounds. In addition, previous site-wide composite sampling performed by Blymyer Engineers (Blymyer, 1989) did not detect the presence of TPHd, PCBs, organochlorine pesticides or herbicides in shallow soil samples.

- Debris Pile: Pesticides were detected in 3 of the 4 samples collected in the debris pile area. Several metals were detected in soil samples collected in the Debris Pile area. No herbicides, SVOCs, or VOCs were detected in samples collected in the Debris Pile area.

7.0 REFERENCES

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TABLE 1

Analytical Soil Testing Summary

Bel Marin Keys Unit V Property

Marin County, California

Sample ID	Chemical Analyses with Method Number												
	TPHg (8015M)	TPHd (8015M) with silica gel cleanup	TPH as motor oil	Fuel Oxygenates and BTEX (8260)	Metals (6000/ 7010)	PAHs (8270)	Phenols (8270)	SVOCs (8270)	VOCs (8260)	Herbi-cides (8151A)	Pesti-cides (8081)	Dioxins (8280)	PCBs (8080)
Above Ground Tank Area													
ShS-AGT-1s	X	X		X	X	X							
ShS-AGT-2d	X	X		X	X	X							
West Barn Area													
SS-West Barn-1							X			X	X		
SS-West Barn-2							X			X	X		
SS-West Barn-3							X			X	X		
Comp-West Barn												X	
East Barn Area													
SS-East Barn-1							X			X	X		
SS-East Barn-2							X			X	X		
SS-East Barn-3							X			X	X		
Comp-East Barn												X	
Crop Duster Area													
SS-Duster-1							X			X	X		

TABLE 1

Analytical Soil Testing Summary

Bel Marin Keys Unit V Property

Marin County, California

Sample ID	Chemical Analyses with Method Number												
	TPHg (8015M)	TPHd (8015M) with silica gel cleanup	TPH as motor oil	Fuel Oxygenates and BTEX (8260)	Metals (6000/ 7010)	PAHs (8270)	Phenols (8270)	SVOCs (8270)	VOCs (8260)	Herbi-cides (8151A)	Pesti-cides (8081)	Dioxins (8280)	PCBs (8080)
Drainage Ditches/Field Area													
SS-Ditch-1							X			X	X		
SS-Ditch-2							X			X	X		
SS-Ditch-3							X			X	X		
SS-Ditch-4							X			X	X		
SS-Ditch-5							X			X	X		
Comp-Ditch												X	
Samples Collected by Others													
S-1		X											
S-2		X											
S-3		X											
S-4		X											
S-5		X											
S-6		X											
Comp 7, 19, 20, 21			X							X	X		X
Comp 15, 16, 17, 18			X							X	X		X
Comp 8, 9, 10, 11			X							X	X		X
Comp 12, 13, 14, 22			X							X	X		X

TABLE 1

Analytical Soil Testing Summary

Bel Marin Keys Unit V Property

Marin County, California

Sample ID	Chemical Analyses with Method Number												
	TPHg (8015M)	TPHd (8015M) with silica gel cleanup	TPH as motor oil	Fuel Oxygenates and BTEX (8260)	Metals (6000/ 7010)	PAHs (8270)	Phenols (8270)	SVOCs (8270)	VOCs (8260)	Herbi-cides (8151A)	Pesti-cides (8081)	Dioxins (8280)	PCBs (8080)
Debris Pile Area													
SS-Debris-N-1s					X			X		X	X		
SS-Debris-N-2s					X			X		X	X		
SS-Debris-N-3s					X			X		X	X		
SS-Debris-N-4s					X			X		X	X		
SS-Debris-N-1d									X				
SS-Debris-N-2d									X				
SS-Debris-N-3d									X				
SS-Debris-N-4d									X				

Notes:

BTEX = Benzene, toluene, ethylbenzne, and xylenes
PAHs = Polynuclear aromatic hydrocarbons
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds

TPH = Total petroleum hydrocarbons
TPHd = Total petroleum hydrocarbons as diesel
TPHg = Total petroleum hydrocarbons as gasoline
VOCs = Volatile organic compounds

TABLE 2

Petroleum Hydrocarbons, BTEX, and Fuel Oxygenates in Soil

Bel Marin Keys Unit V Property

Marin County, California

Sample ID	Date Sampled	Sample Depth (ft bgs)	Analyzed Chemcials											
			Petroleum Hydrocarbons (mgkg)			BTEX (ug/kg)				Fuel Oxygenates (ug/kg)				
			TPHg	TPHd	TPHmo	B	T	E	X	MTBE	DPE	ETBE	TAME	TBA
Above Ground Tank Area														
ShS-AGT-1s	8/7/00	1.5	<1.00	586	--	<5.0	<5.0	<5.0	<5.0	<50.0	<50.0	<50.0	<50.0	<100
ShS-AGT-2d	8/7/00	2.5	<1.00	304	--	<5.0	<5.0	<5.0	<5.0	<50.0	<50.0	<50.0	<50.0	<100
Drainage Ditches/Field Area (1)														
S-1	1/12/89		--	<10	<10	--	--	--	--	--	--	--	--	--
S-2	1/12/89		--	<10	<10	--	--	--	--	--	--	--	--	--
S-3	1/12/89		--	<10	<10	--	--	--	--	--	--	--	--	--
S-4	1/12/89		--	<10	<10	--	--	--	--	--	--	--	--	--
S-5	1/12/89		--	<10	<10	--	--	--	--	--	--	--	--	--
S-6	1/12/89		--	<10	<10	--	--	--	--	--	--	--	--	--

Notes:

B = Benzene
BTEX = Benzene, toluene, ethylbenze, and xylenes
DPE = Disiopropyl ether
E = Ethylbenzene
ETBE = Ethyl tertiary butyl ether
MTBE = Methyl tertiary butyl ether
TAME = Tertiary amyl methyl ether
TBA = Tertiary butyl alcohol
T = Toluene
TPHg = Total petroleum hydrocarbons as gasoline
TPHd = Total petroleum hydrocarbons as diesel, run with Silica Gel Cleanup
TPHmo = Total petroleum hydrocarbons as motor oil
X = Xylenes
ft bgs = feet below ground surface
mg/kg = milligram per kilogram
ug/kg = micrograms per kilogram
-- = Not analyzed
< = Not detected above the laboratory limit stated

1. Noted samples were collected by Blymer Engineers

TABLE 3
Metals in Soil
Bel Marin Keys Unit V Property
Marin County, California

Sample ID	Date Sampled	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
		Analyzed Metals (mg/kg)																
Above Ground Tank Area																		
ShS-AGT-1s	8/7/00	--	--	--	--	<5.0	32.5	--	--	271	--	--	40.2	--	--	--	--	146
ShS-AGT-2d	8/7/00	--	--	--	--	<5.0	81.7	--	--	12.8	--	--	130	--	--	--	--	60.8
Debris Pile Area																		
SS-Debris-N-1	8/7/00	<5.0	36	113	<5.0	20.0	81	28.1	191	650	<0.100	15.5	90	<5.0	<5.0	<5.0	32	3,931
SS-Debris-N-2	8/7/00	<5.0	12	219	<5.0	<5.0	64	11.7	46	130	0.25	<5.0	61	<5.0	<5.0	<5.0	55	319
SS-Debris-N-3	8/7/00	<5.0	12	100	<5.0	<5.0	50	11.3	37	88	0.20	<5.0	54	<5.0	<5.0	<5.0	44	172
SS-Debris-N-4	8/7/00	<5.0	10	54	<5.0	<5.0	54	11.3	30	29	<0.100	<5.0	57	<5.0	<5.0	<5.0	50	83

Notes:

mg/kg = Milligrams per kilogram

< = Not detected above laboratory limit stated

TABLE 4

Polynuclear Aromatic Hydrocarbons ("PAHs") in Soil

Bel Marin Keys Unit V Property

Marin County, California

Sample ID	Date Sampled	PAHs (ug/kg)
Above Ground Tank Area		
ShS-AGT-1s	8/7/00	<500
ShS-AGT-2d	8/7/00	<50

Notes:

ug/kg = Micrograms per kilogram

< = Not detected above the laboratory limit stated

TABLE 5

Organochlorine Pesticides, Chlorinated Herbicides, and PCBs in Soil

Bel Marin Keys Unit V Property

Marin County, California

Sample ID	Date Sampled	Analyzed Chemcials [1] Detected Organochlorine Pesticides (ug/kg)			Chlorinated Herbicides (ug/kg)	PCBs (mg/kg)
		4,4-DDE	4,4-DDD	4,4-DDT		
East Barn Area						
SS-East Barn-1	8/7/00	<10.0	<10.0	<10.0	ND	--
SS-East Barn-2	8/7/00	<10.0	<10.0	<10.0	ND	--
SS-East Barn-3	8/7/00	<10.0	<10.0	67.7	ND	--
Crop Duster Area						
SS-Duster-1	8/7/00	<10.0	<10.0	<10.0	ND	--
West Barn Area						
SS-West Barn-1	8/7/00	<10.0	<10.0	20.8	ND	--
SS-West Barn-2	8/7/00	<10.0	<10.0	<10.0	ND	--
SS-West Barn-3	8/7/00	<10.0	<10.0	<10.0	ND	--
Drainage Ditches/Field						
SS-Ditch-1	8/7/00	<10.0	<10.0	<10.0	ND	--
SS-Ditch-2	8/7/00	<10.0	<10.0	<10.0	ND	--
SS-Ditch-3	8/7/00	<10.0	<10.0	<10.0	ND	--
SS-Ditch-4	8/7/00	<10.0	<10.0	<10.0	ND	--
SS-Ditch-5	8/7/00	<10.0	<10.0	<10.0	ND	--
Comp 7, 19, 20, 21	1/12/89	<20	<20	<20	ND	ND
Comp 15, 16, 17, 18	1/12/89	<20	<20	<20	ND	ND
Comp 8, 9, 10, 11	1/12/89	<20	<20	<20	ND	ND
Comp 12, 13, 14, 22	1/12/89	<20	<20	<20	ND	ND

TABLE 5

Organochlorine Pesticides, Chlorinated Herbicides, and PCBs in Soil

Bel Marin Keys Unit V Property

Marin County, California

Sample ID	Date Sampled	Analyzed Chemcials [1]				
		Detected Organochlorine Pesticides (ug/kg)			Chlorinated Herbicides (ug/kg)	PCBs (mg/kg)
		4,4-DDE	4,4-DDD	4,4-DDT		
Debris Pile Area						
SS-Debris-N-1s	8/7/00	<10.0	<10.0	18.5	ND	--
SS-Debris-N-2s	8/7/00	68.9	68.5	11.5	ND	--
SS-Debris-N-3s	8/7/00	<10.0	<10.0	56.1	ND	--
SS-Debris-N-4s	8/7/00	<10.0	<10.0	<10.0	ND	--

Notes:

DDD = Dichlorodiphenyldichloroethane
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
mg/kg = Milligrams per kilogram
ND = Not detected above the laboratory reporting limit (see analytical test sheets)
ug/kg = Micrograms per kilogram
< = Not detected above the laboratory limit stated
-- = Not analyzed

1. Detected values reported on a dry weight basis.
2. Laboratory reporting limits for herbicides range between 0.1 and 100 micrograms per gram

TABLE 6
Phenols in Soil
Bel Marin Keys Unit V Property
Marin County, California

Sample ID	Date Sampled	Phenols (ug/kg)
East Barn Area		
SS-East Barn-1	8/7/00	ND
SS-East Barn-2	8/7/00	ND
SS-East Barn-3	8/7/00	ND
Crop Duster Area		
SS-Duster-1	8/7/00	ND
West Barn Area		
SS-West Barn-1	8/7/00	ND
SS-West Barn-2	8/7/00	ND
SS-West Barn-3	8/7/00	ND
Drainage Ditches/Field		
SS-Ditch-1	8/7/00	ND
SS-Ditch-2	8/7/00	ND
SS-Ditch-3	8/7/00	ND
SS-Ditch-4	8/7/00	ND
SS-Ditch-5	8/7/00	ND

Notes:

ug/kg = micrograms per kilogram
ND = Not detected above the laboratory reporting limit
(see analytical test sheets)

1. Laboratory reporting limits range from 660 to 1,600 ug/kg.

TABLE 7
Dioxins in Soil
Bel Marin Keys Unit V Property
Marin County, California

Sample ID	Compound Concentrations (ng/g) [1]						
	2,3,7,8-TCDD	1,2,3,7,8-PeCDD	1,2,3,4,7,8-HxCDD	1,2,3,6,7,8-HxCDD	1,2,3,7,8,9-HxCDD	1,2,3,4,6,7,8-HpCDD	OCDD
East Barn Area (Comp)	<0.00118	<0.00336	<0.00182	<0.00179	<0.00171	0.0121	0.0735
West Barn Area (Comp)	<0.000403	<0.000820	<0.00101	<0.00109	<0.000997	0.0138	0.0280
Ditch Area (Comp)	<0.000452	<0.00123	<0.00223	<0.00217	<0.00207	0.00560	0.0266

TABLE 7
Dioxins in Soil
Bel Marin Keys Unit V Property
Marin County, California

Sample ID	Compound Concentrations (ng/g) (1)									
	2,3,7,8-TCDF	1,2,3,7,8-PeCDF	2,3,4,7,8-PeCDF	1,2,3,4,7,8-HxCDF	1,2,3,6,7,8-HxCDF	1,2,3,7,8,9-HxCDF	2,3,4,6,7,8-HxCDF	1,2,3,4,6,7,8-HpCDF	1,2,3,4,7,8,9-HpCDF	OCDF
East Barn Area (Comp)	0.00177	<0.00126	0.0131	<0.00134	0.00308	<0.00168	0.00433	0.00713	<0.00368	<0.00533
West Barn Area (Comp)	<0.000420	<0.000679	<0.000815	<0.000430	<0.000446	<0.000663	<0.000369	<0.00189	<0.00238	<0.00226
Ditch Area (Comp)	0.00157	<0.00193	<0.00208	<0.00153	<0.00141	<0.00213	<0.00120	<0.00152	<0.00194	<0.00134

TABLE 7

Dioxins in Soil

Bel Marin Keys Unit V Property

Marin County, California

Sample ID	Compound Concentrations (ng/g) [1]							
	Total TCDD	Total PeCDD	Total HxCDD	Total HpCDD	Total TCDF	Total PeCDF	Total HxCDF	Total HpCDF
East Barn Area (Comp)	<0.00118	<0.00336	0.0142	0.0269	0.0656	0.140	0.0643	0.0154
West Barn Area (Comp)	<0.000403	<0.000820	0.00416	0.0223	<0.000420	0.00239	0.00413	<0.00210
Ditch Area (Comp)	0.00122	<0.00123	<0.00215	0.0125	0.0252	0.00257	<0.00151	<0.00171

Notes:

Hp = Hepta
Hx = Hexa
O = Octa
Pe = Penta

T = Tetra
CDD = Polychlorinated Dibenzo-p-dioxins
CDF = Polychlorinated Dibenzofurans
comp = Composite sample

ng/g = Nanograms per gram
TCDD = Tetrachlorodibenzo-p-dioxin
TCDF = Tetrachlorodibenzofuran
< = Not detected above the laboratory limit stated

1. Values reported on a dry weight basis.

TABLE 8

Semivolatile Organic Compounds ("SVOCs") and Volatile Organic Compounds ("VOCs") in Soil

Bel Marin Keys Unit V Property

Marin County, California

Sample ID	Date Sampled	SVOCs (ug/kg)	VOCs (ug/kg)
Debris Pile Area			
SS-Debris-N-1s	8/7/00	ND	--
SS-Debris-N-2s	8/7/00	ND	--
SS-Debris-N-3s	8/7/00	ND	--
SS-Debris-N-4s	8/7/00	ND	--
SS-Debris-N-1d	8/7/00	--	ND
SS-Debris-N-2d	8/7/00	--	ND
SS-Debris-N-3d	8/7/00	--	ND
SS-Debris-N-4d	8/7/00	--	ND

Notes:

ug/kg = micrograms per kilogram

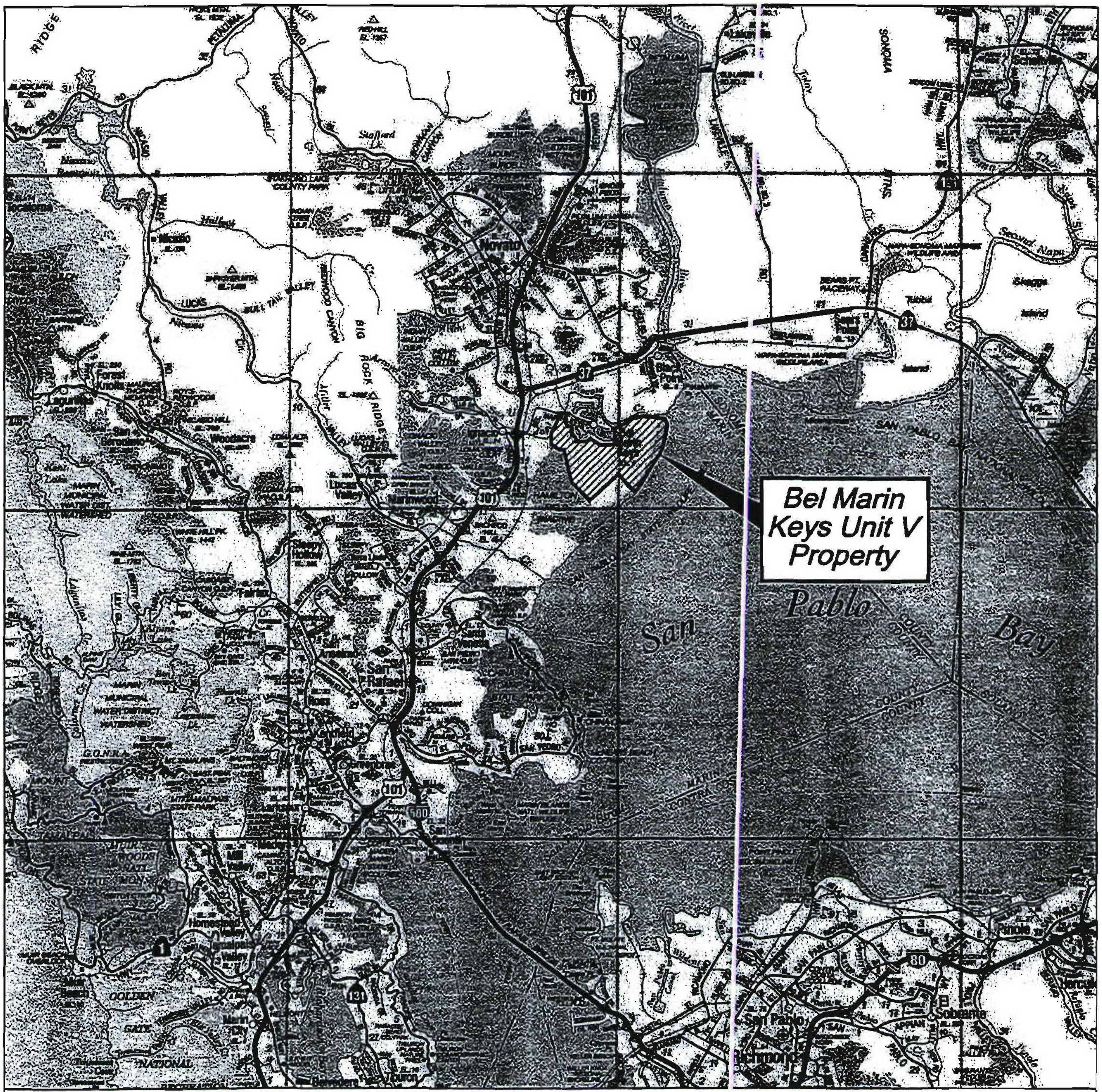
ND = Not detected above the laboratory reporting limit

-- = not analyzed

1. Laboratory reporting limits for SVOCs range between 330 and 1,600 ug/kg.
2. Laboratory reporting limits for VOCs range between 5.0 and 100 ug/kg.

TABLE 9
Moisture Content
Bel Marin Keys Unit V Property
Marin County, California

Sample ID	Date Sampled	Moisture Content (%)
Above Ground Tank Area		
ShS-AGT-1s	8/7/00	3.28
ShS-AGT-2d	8/7/00	5.71
East Barn Area		
SS-East Barn-1	8/7/00	7.67
SS-East Barn-2	8/7/00	15.0
SS-East Barn-3	8/7/00	11.5
Crop Duster Area		
SS-Duster-1	8/7/00	12.3
West Barn Area		
SS-West Barn-1	8/7/00	18.8
SS-West Barn-2	8/7/00	28.0
SS-West Barn-3	8/7/00	16.5
Drainage Ditches/Field Area		
SS-Ditch-1	8/7/00	37.0
SS-Ditch-2	8/7/00	59.2
SS-Ditch-3	8/7/00	61.5
SS-Ditch-4	8/7/00	49.1
SS-Ditch-5	8/7/00	58.0
Debris Pile Area		
SS-Debris-N-1s	8/7/00	22.3
SS-Debris-N-2s	8/7/00	10.6
SS-Debris-N-3s	8/7/00	18.6
SS-Debris-N-4s	8/7/00	20.9



Reference: San Francisco Bay Region AAA Map, 1997.

Erler & Kalinowski, Inc.

Site Location Map

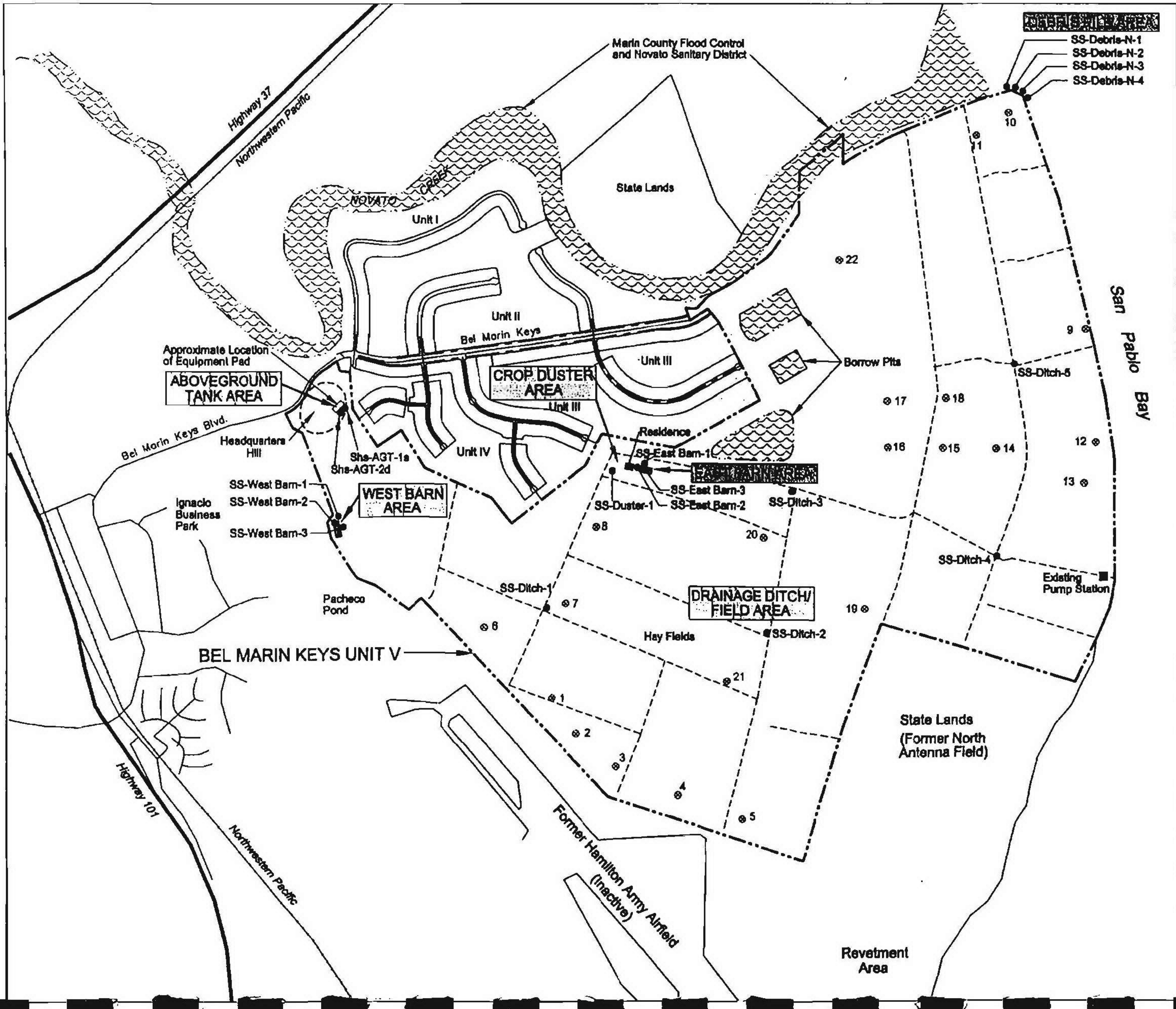
N

0 3 6

(Approximate Scale in Miles)

Bel Marin Keys Unit V Property
Marin, CA
March 2002
EKI A00065.00

Figure 1



N

0 1500 3000

(Approximate Scale in Feet)

LEGEND

- Approximate Subject Property Boundary
- Creek
- Railroad Tracks
- Existing Ditches
- Approximate Soil Sample Location (Collected by EKI, 2000)
- Approximate Soil Sample Location (Collected by Blymyer, 1989)

Notes:

1. All locations are approximate.

Erler & Kalinowski, Inc.

Soil Sampling Locations

Bel Marin Keys Unit V Property
Marin County, CA
March 2002
EKI A00065.00
Figure 2

Appendix C

Geotechnical Design Requirements

Appendix C
Geotechnical Design Requirements

1.0 Introduction

This document presents the preliminary geotechnical evaluation of the proposed Bel Marin Keys V (BMK-V) expansion to the authorized Hamilton Wetland Restoration Project (HWRP). Relevant information on the regional geological setting and geotechnical properties of the site is provided here.

The BMK-V parcel is directly adjacent to the Hamilton Airfield, to the north, on the fringe of San Pablo Bay. Both properties historically consisted of nearly level mudflats and tidal marsh that was levied off from tidal action to create agricultural lands. The first levees around the BMK site were constructed in 1892. Both parcels of land are underlain by thick layers of Bay Mud and have settled significantly as a result of the separation of waters of San Pablo Bay and the surrounding watershed. The majority of the geotechnical data used in this evaluation were obtained from the 1995 BMK site investigation conducted by Miller Pacific Engineering Group for the California Quartet's proposed residential development of the property. However, due to the close proximity, geomorphic continuity, and similar recent history of the two sites, valuable qualitative information for BMK may be derived from existing investigations of the Hamilton Airfield property as well.

The US Army Corps of Engineers have identified four primary geotechnical issues that potentially impact the proposed project expansion. These include long-term settlement, compactability of dredged material, levee stability, and levee performance during and after an earthquake.

For the purposes of this evaluation, it is assumed that the subsurface site conditions do not deviate significantly from those described in the subject report[1]. The basic design and construction procedures for levees and embankments provided in the subject report are very similar to those proposed for the BMK expansion to the HWRP. The estimates provided here would be refined based on additional site-specific information obtained during the pre-construction, engineering and design phase of the expanded project.

Previous Studies

The following documents were used as reference material for the analysis contained in this appendix.

1. Geotechnical Investigation Bel Marin Keys Unit 5 Marin County, California, Volumes I and II, December 21, 1995, Miller Pacific Engineering Group
2. Draft Supplemental Environmental Impact Report/Environmental Impact Statement (SEIR/EIS), Bel Marin Keys Unit V Expansion of the Hamilton Wetland Restoration Project, May 2002, Jones & Stokes.

[1] Geotechnical Investigation Bel Marin Keys Unit 5 Marin County, California, Volumes I and II, December 21, 1995, Miller Pacific Engineering Group

3. Hamilton Restoration Plan, Volume I: Feasibility Study. December 1998. California State Coastal Conservancy and the U.S. Army Corps of Engineers, San Francisco District.

2. Regional Geologic Setting

The site is located within California's geologically and seismically active Coast Range Geomorphic Province. The province is characterized by a series of northwest trending faults, mountain ranges, and valleys. These include three dominant faults: the Hayward fault to the southeast, the San Andreas fault to the west, and the Healdsburg-Rogers Creek fault to the northeast (Environmental Science Associates 1993 as cited in the Draft SEIR/EIS May 2002). The Draft Supplemental Environmental Impact Report/Environmental Impact Statement (SEIR/EIS) for Bel Marin Keys Unit V Expansion of the Hamilton Wetland Restoration Project (HWRP) describes in detail factors that could potentially impact the project site. These include, potential surface fault rupture, ground failure hazards, seismicity and geologic hazards, ground shaking, and earthquake-induced inundation.

However, no active or potentially active faults are known to exist within the boundaries of the site. In addition, the site is not within the Alquist-Priolo Special Studies Zone, as designated by the California Division of Mines and Geology (Hart and Bryant 1997 as cited in the Draft SEIR/EIS May 2002). Accordingly, the potential for surface fault rupture to occur at the site is remote (Miller Pacific Engineering Group 1995).

The site is underlain by unconsolidated alluvium. Ground shaking at the site during an earthquake is likely to be more intense than in nearby areas underlain by bedrock. The magnitude of the maximum credible earthquake is: 7.5 Richter scale magnitude (M) for Hayward fault, 8.3 M for San Andreas faults, 7.2 M for the Healdsburg-Rogers Creel fault (Draft SEIR/EIS May 2002). Although ground shaking may be intense, there is little or no potential for seismic settlement to occur because the soils and bay mud that underlie the site consist of clays and silty clays rather than clean sands and silts (Miller Pacific Engineering Group 1995). However, cracking of the ground surface ('lurch cracking') during an earthquake may occur along the edge of embankments underlain by soft, compressible soils (Miller Pacific Engineering Group 1995).

2.1 Geotechnical Conditions

As mentioned above, both the BMK and Hamilton sites have subsided from historic marsh plain levels and are currently below sea level. Current elevations for the BMK parcel range from approximately –4 feet to –5 feet on the National Geodetic Vertical Datum (NGVD, 1929). The site is protected from tidal inundation by flood control levees along San Pablo Bay and Novato Creek, and by a system of drainage trenches and pumps.

According to the Soil Survey of Marin County (Kashiwagi 1985 as cited in Draft SEIR/EIS May 2002), the bay mud deposits that underlie the site are overlain entirely by soils of the Reyes series, also referred to as "desiccated crust." Desiccated crust is the upper, near surface, layer of the Bay Mud exposed for a sufficiently long time for the loss of moisture to cause over consolidation, shrinkage and oxidation of the soil, i.e. mottling.

Soils of the Reyes series typically consist of slowly permeable clays and silty clays (Miller Pacific Engineering Group (1995). Soils of the Reyes series are still susceptible to settlement when dewatered or subjected to large static fill loads. Due to the fine texture of the Reyes soil and the low slope gradients that prevail at the site, the hazard of soil erosion is slight.

The bay mud is a plastic, silty clay to clayey silt, with high compressibility, low shear strength, and generally low permeability. Compressibility properties for the Reyes clay soils and bay mud are shown in Table 1.

Table 1. Compressibility properties for bay mud and Reyes soils at BMK (Miller Pacific Engineering Group 1995).

Compressibility property	Reyes soil ("desiccated crust")	Bay mud
Virgin compression ratio, $C_{\varepsilon C}$	0.21	0.36
Vertical coefficient of consolidation, C_V (ft^2/yr)	10	10

The bay mud is underlain by much stronger and less compressible alluvial and residual soils and bedrock (Miller Pacific Engineering Group, 1995) Due primarily to its high compressibility and low strength, the soft bay mud poses considerable challenges to development of the site as a wetland. New fill loads cause compression of underlying bay mud, and may cause uneven settlement of the surface. Depending on the depth of the underlying bay mud, the settlement may continue for long periods of up to 50 to 100 years.

Settlement curves for estimating the anticipated amount of settlement of soft bay mud were generated for a proposed residential development by Miller Pacific Engineering Group in 1995. In the adjacent HWRP project, conceptual settlement curves were also generated for large-area fill loads (e.g. general blanket fills) and more localized fill loads (e.g. levee fills). Fills applied over limited areas may cause shear stresses in the bay mud that, if they exceed the soil's shear strength, could cause stability failures of the levees.

3. Geotechnical Issues Common to BMK Expansion Alternatives 1, 2, and 3

The three alternatives under consideration for this study are:

1) Dredged material placement with an enlarged Pacheco Pond
2) Dredged material placement with seasonal wetlands
3) Natural sedimentation with an enlarged Pacheco Pond.

The key geotechnical characteristics common to the three alternatives are described below.

<u>3.1 Levees and Tidal Wetland Settlement</u>

The amount of settlement will vary depending on the thickness of the fill placed, groundwater level and the thickness of underlying Bay Mud (Miller Pacific Engineering Group, 1995). Bay Mud thickness varies from 30 feet on the west side of the site near Pacheco Pond to 90 feet on the northeast corner bordering Novato Creek. Because of the varying thickness of bay mud thickness and levee/tidal marsh, it is likely that differential

settlements will occur. Under Alternatives 1-3, differential settlement is likely to be encountered on the northwestern portion of the site where abrupt changes in the thickness of the Bay Mud deposits are reported and near the expanded portion of Pacheco Pond under Alternatives 1 and 3.

For this preliminary evaluation, settlement estimates were done using soil consolidation data from reports of Miller Pacific Engineering (1995) and the HWRP Feasibility Study (1998). Settlement curves from HWRP Feasibility Study cover a 50-year design period. On the other hand, a 100-year design period was used to generate the settlement curves from Miller Pacific report. The settlement curves from Miller Pacific report were developed from laboratory consolidation tests performed on bay mud samples obtained at the BMKV site.

3.1.1 Tidal/Non-Tidal Marsh Settlement

The amount of settlement associated with placement of dredged material in the tidal and non-tidal marsh areas was estimated using compressibility data presented in Table 1 and the conceptual settlement curves provided in HWRP Feasibility Study report. Settlement estimates in the marsh areas are presented in Table 2. The total settlement of foundation soil in the tidal marsh area is expected to vary from less than 1 foot to greater than 3 feet depending on the bay mud thickness. The estimated settlement values presented in Table 2 are long-term settlement that may vary from 30 years for a 30 feet thick bay mud to more than 50 years for a 90 feet thick bay mud. For the first 5 years after dredged material placement, the settlement values are estimated to range from 0.3 to 1.8 feet depending on fill thickness. In general, the expected settlement using the Miller Pacific data appears to produce greater settlement compared with the conceptual settlement estimates using the HWRP curves (Table 2).

Table 2. Estimated Settlement and Dredged Fill Material Requirements for Tidal Marsh Areas of the Proposed BMK-V Expansion.#

Geotechnical Feature	Approx. Present Ground surface Elevation (ft) NGVD	Estimated Thickness of bay mud (ft)	Ground-water Elevation (ft)	Top Elevation of feature (ft)	Approx. Height of Feature (ft)	Fill Thickness Needed *	Estimated total settlement in feet using Miller Pacific soils data (1995)	Estimated total settlement in feet using HWRP curves ** (1998)
Tidal marsh	-5	20	-5	2	7	7.8	NA	0.8
	-5	40	-5	2	7	(8.5-9.9)	2.9	1.5
	-5	60	-5	2	7	(9.0-10.2)	3.2	2.0

* Fill thickness required to meet final design elevation for one time placement
** HWRP settlement curves available only for 20, 40 and 60 feet Bay Mud
(8.5-9.9) - fill thickness needed using both settlement estimates from HWRP & Miller, respectively
\# Total settlement estimates based on 30 to more than 50 years (HWRP); and 100 years (Miller Pacific)
Top elevation obtained from draft SEIR/EIS May 2002 report.

3.1.2 Levee Settlement

Settlements for new and improved levees proposed in the BMK expansion alternatives will vary depending on the thickness of the fill placed, groundwater level and the thickness of underlying Bay Mud. For both levee construction and tidal marsh

restoration, the expected settlement of the underlying Bay Mud due to the weight of the applied fill material between 10 and 30 percent of total fill height.

As the site is underlain by Bay Mud that is highly compressible, the design must account for settlement of the levees that will occur over time. An alternative design measure, staged construction, was evaluated to address the settlement issue. If staged construction were employed, levee material would have to be temporarily stored on site for future use in levee staged construction, as the restored habitat would cover the borrow sites.

Staged construction merits further consideration as this would address the visual impact issue important to the BMK residential community. To reduce any visual impact resulting from levee height construction near the existing BMK residential community, fill placement for new levees may be done in two stages or more over the design period of 50 years. A concept similar to the method developed by Olson (1977) and later adapted in NAVFAC DM7.1 was used to estimate the consolidation settlement under time-dependent loading.

Fill placement will consist of constructing the flood control levee in two or more stages to an initial elevation of 10.0 feet NGVD or 15 feet of fill. Settlement is expected after each fill placement. It is estimated that in 50 years the crest elevation will stabilize to a crest elevation of about 8.0 feet.

The improved levee separating the BMK south lagoon from the project site has an existing crest elevation from 2 to 5 feet NGVD. It is estimated that in more than 10 years since the south lagoon levee was constructed about 60 percent consolidation has occurred leaving approximately one foot of residual settlement. This calculation is based on consolidation of 40-foot thick San Francisco Bay Mud, which appear to underlie the improved levee (Miller Pacific Engineering, 1995). The total settlement of 2.5 feet was obtained using the conceptual settlement curves from the adjacent Hamilton Airfield Wetland Restoration Project.

The proposed improvements to the south lagoon levee will consist of fill placement on the levee to elevation 6.0 feet and about 2 to 3 feet of fill at the toe of the levee on the wetland side. It is estimated that the additional fill can be accommodated to achieve a final crest elevation of 5 feet NGVD.

The estimates on fill thicknesses, settlements, and fill staging sequence must be verified by conducting a subsurface sampling and testing program at the subject site and closely monitored during construction to avoid over or underfilling.

3.2 Dredged Material Properties for Fill Material and Levee Construction

The levees and tidal marsh area will be constructed using fill material excavated from the site and possibly dredged material imported from offsite sources such as the Port of Oakland, Richmond Harbor, Pinole Shoal Channel, and Petaluma River Channel. Table 3 provides information on quantities and material types from offsite sources of dredged material for use at the project site.

Table 3. Dredged material type distribution (Moffat & Nichols Engineers).

Material Type	Quantity (cu.yd.)	% Total
Dense sand	2,000,000	19.64
Sandy silt	794,000	7.8
Silty loam	1,060,680	10.41
Silt & clays	6,330,020	62.15

Alternatives 1 and 2 would utilize dredged material to establish initial surface elevations of the wetlands and potentially to create levees if adequate on site borrow material was not readily available. Initially, the dredged material that is pumped to the site is expected to contain 20% dredged material and 80% water by volume, which means that the dredged material may be too wet and not suitable for compaction. In order for the dredged material to be used as fill material for levee construction, dewatering may need to be done in a location off the fill areas. This would allow the dredged material to dry and be moisture-conditioned to make it suitable for compaction. Issues related placement and compaction of the material need to be addressed during the design and construction phases. Since about 25% of the material consists of sand, soil stabilization may be required if this material is used for levee construction.

Prior to the use of dredged material for levee construction, testing and analysis must be carried out to confirm its suitability for use. The laboratory testing should include the determination of the material's compaction characteristics; shear strength of the compacted material, compressibility, and expansion potential for use in the design. A literature search of the engineering characteristics of the dredged material should also be conducted to provide supplemental information for the design phase.

3.3 Levee Stability

Slopes of levees constructed with onsite soils (not dredged material) and having an inclination of 2H:1V to 3H:1V (horizontal to vertical) generally have been shown by Miller Pacific Engineering Group to have factors of safety greater than the recommended FS of 1.3 (USACE EM 1110-2-1913). Existing levee top elevations at different locations are summarized in Table 4. Stability analyses will be performed for the levees using appropriate shear strength parameters obtained from laboratory testing. A computer program such as UTEXAS3 developed by the University of Texas or other equivalent programs will be used to perform the analyses. Similarly, the factors of safety against bearing capacity failure must also be analyzed to ensure that the bay mud shear strengths will not be exceeded.

Table 4. Summary of Existing Levee Elevations Surrounding the BMK-V Parcel

Levee boundary location	Approximate levee top elevation (NGVD)
BMK-V / San Pablo Bay	6-10
BMK-V / Novato Creek	5-8
BMK-V / BMK lagoon	2-5
BMK-V / Pacheco Pond	8-11
BMK-V / Hamilton Airfield	1-5

Ref: Draft SEIR/EIS for BMKV, May 2002, Jones & Stokes.

3.4 Seismic Considerations

Ground failure hazards such as liquefaction, earthquake-induced settlement, and lurching are processes that involve the displacement of the ground surface resulting from a loss of strength or failure of the underlying materials due to strong seismic ground motions.

Because the Reyes soils ('desiccated crust') and bay mud deposits do not contain substantial quantities of clean sands and silts, they are not conducive to liquefaction (the sudden loss of soil strength during strong ground shaking) and earthquake-induced settlement. However, there is a potential for earthquake-induced lurch cracking to occur at the site during an earthquake (Miller Pacific Engineering Group 1995).

3.5 Novato Sanitation District Outfall

The new installation of a new sanitary outfall pipeline would be located slightly below the grade of the existing pipeline and along the alignment that separates the project site from the adjacent HWRP parcel and around the east side of the expanded Pacheco Pond. As described in more fully in the BMK-V EIR/EIS, the existing sewer outfall pipeline would be replaced because of potential differential settling and leakage resulting from levee construction and tidal marsh restoration.

3.6 Utility Protection

To protect the 5 electric transmission line towers on the proposed BMK expansion area from erosion and corrosion, concrete jackets will be constructed at the base of the towers. Utility service will not be affected during this activity. Experience from the Sonoma Baylands Wetland Restoration Project, which has similar towers for the same power transmission lines that also cross that site, indicates that there are minimal impacts to the foundations of the towers associated with placement of dredged material around the tower base. However, should future work reveals potential impact on tower foundation capacity as a result of down drag forces from weight of overlying fill and settlement of the underlying bay mud, necessary investigative and corrective measures should be done.

Geotechnical Issues Unique to Alternatives

♦ **Alternative 1**: Dredged Material Placement with Enlarged Pacheco Pond

Alternative 1 would entail enlarging the existing Pacheco Pond by approximately 50 acres, which would result in greater fresh water habitat. Under this alternative, the bottom elevation of Pacheco Pond would remain at the existing elevation of -3 feet NGVD and the water surface level at +1.5 feet NGVD. A new flood protection levee would be constructed along the east side of Pacheco Pond and would extend north to Novato Creek. Potential differential settlement would likely occur at the transition from the levee to Pacheco Pond because of varying overburden pressure and abrupt change in bay mud thickness in the area.

♦ **Alternative 2**: Dredged Material Placement with Seasonal Wetlands

Alternative 2 would expand the existing Pacheco Pond and the swale south of the BMK south lagoon. This would involve constructing improved and new levees to lower design heights of 5 feet and 8 feet NGVD, respectively. A levee with an initial top elevation of approximately 10 feet NGVD (with a 2-foot settlement allowance, resulting in a design elevation of 8 feet NGVD) would be constructed across the middle portion of the site to separate the non-tidal and tidal habitats. The existing levee along the BMK south lagoon would be improved to an initial top elevation of 6 feet NGVD, which includes a 1-foot settlement allowance, resulting in a design elevation of 5 feet NGVD. Staged fill placement for new levee construction would be done in two stages or more over the design period of 50 years. Settlement is expected after each fill placement but is estimated to stabilize to the design crest elevation.

♦ **Alternative 3**: Natural Sedimentation with Enlarged Pacheco Pond

With the exception of levee construction and dredge material placement in the tidal/non-tidal marsh basins, Alternative 3 is identical to Alternative 1 in terms of the creation of an enlarged Pacheco Pond. Approximately 727,000 cubic yards of dredged material would be required to create levees, interior peninsulas and berms.

5. Summary and Recommendations

To address the various geotechnical concerns associated with the Bel Marin Keys V expansion, detailed geotechnical site investigations need to be conducted to generate data specific to the site and project features. The investigations would further evaluate subsurface conditions encountered at the site (e.g. thickness and compressibility of the bay mud deposits).

5.1 Settlement

Levee construction and dredged material placement in the tidal marsh area for the selected restoration alternative should compensate for the anticipated settlement. Additional fill material due to settlement is estimated at 10 to 40 percent of the total fill height. The specific techniques used to compensate for anticipated settlement would depend on the findings of the design level geotechnical investigations, but could include: (a) placement of additional fill above the intended finish grade of levees to compensate for anticipated settlement and sea level rise; (b) application of surcharge loads or other settlement acceleration techniques; or (c) avoidance of excessive fill placement.

5.2 Slope Stability

The stability of levees needs to be addressed during the design and construction phases. Side slopes of 3 horizontal to 1 vertical or flatter are used for this conceptual design and evaluation. If dredged material is used for levee construction, it should be determined whether an acceptable margin of safety could be achieved.

5.3 Fill Material Properties

Should it become necessary to use dredged material for levee construction, further investigation is recommended to determine its strength and compaction characteristics. Preliminary data indicate that about 25% by volume of the total imported dredged material could be characterized as cohesionless (i.e. sand), which raises stability concerns. Due to the extremely high moisture content (80% water by volume) of the dredged material, dewatering operation would be required prior to placement and compaction. In addition, during pumping of dredged material to the site, sands and coarser material would settle first followed by fine-grained silts and clays resulting in material segregation. Because of this, it may be necessary to remix the material to ensure even distribution of material from compaction standpoint.

5.4 Seismic Design Considerations

Ground failure hazards such as liquefaction, earthquake-induced settlement, and lurching are processes that involve the displacement of the ground surface resulting from a loss of strength or failure of the underlying materials due to strong seismic ground motions. There is a potential for earthquake-induced lurch cracking to occur at the site during an earthquake (Miller Pacific Engineering Group 1995). A review of seismic hazards, risks and probable ground motions should be done.

Appendix D

Civil Design Requirements

Appendix D
Civil Engineering Design Requirements

1. Introduction

This appendix describes the principal design features and engineering requirements associated with the proposed expansion of the authorized 1000-acre Hamilton Wetland Restoration Project (HWRP) to include the adjacent 1600-acre Bel Marin Keys -V (BMK-V) parcel.

Figure D-1 is an aerial photograph of the authorized Hamilton Project site, the adjacent BMK-V proposed expansion, and adjacent hydrologic features including Novato Creek to the north, Pacheco Pond to the west and San Pablo Bay to the east. Also clearly visible in the photograph are the bordering Bel Marin Keys and New Hamilton Partners residential communities to the north and south respectively.

The inclusion of the BMK-V expansion furthers the goals of habitat restoration and beneficial re-use of dredged material laid out in the authorized HWRP. The addition of the BMK-V parcel will provide opportunity for far greater reductions to In-Bay disposal practices, and a much broader expanse of nearly contiguous wildlife habitat. There are considerable economies of scale and construction efficiencies associated with the expanded project that are discussed later in this appendix and elsewhere in the re-evaluation report. In addition to the elimination of levees required to separate the two parcels in the current project plans, addition of the BMK parcel allows for greater flexibility in construction phasing and sequencing. Should unforeseen circumstances temporarily prohibit dredged material placement on a specific portion of the combined site, the other portions could be readied to provide adequate capacity for ongoing dredging projects in the Bay Area. The equipment required to Off-load and deliver dredged material to the HWRP site can stay in service throughout construction of the expanded project, and easily accommodate changes to the wetland construction sequencing over the combined site.

Building on the success and broad support for the Hamilton Project, the engineering, design, and construction of the proposed BMK-V expansion will follow the same general guiding principles and approach as the previously authorized project. The reader is referred to the Hamilton Wetland Restoration Plan, Volume 1 Feasibility Report, and in particular the Engineering Appendix B of that report, for the HWRP restoration design and construction philosophy, and specific engineering details previously developed.

Engineering features that will be implemented on the BMK expansion portion of the enlarged project, as identified in the three alternatives presented in the main body of this report, will include:

- Construction of new perimeter levees adjacent to the Bel Marin Keys Community
- Improvements to existing BMK south lagoon levees as required
- Construction of dredged material containment cells and internal peninsulas
- Construction of seasonal wetlands or swales for habitat. The seasonal wetlands also provide flood protection for BMK-V South Lagoon and Pacheco Pond.
- Excavation of suitable onsite borrow materials for levee construction and pre-excavation of main breach channels
- Expansion of Pacheco Pond
- Construction of water control structures
- Dredged material Off-loading facilities
- Dredged material placement for wetland restoration
- Levee breaching and tidal connection to San Pablo Bay

With the exception of the expansion of Pacheco Pond, the engineering features above are common to the previously authorized Hamilton Wetland Restoration Plan and follow the same general design and construction guidelines. All engineering and construction features will be fully developed, analyzed and designed during the planning, engineering and design (PED) phase of the expanded project when Congress Authorizes the addition of the BMK-V parcel to the HWRP. These features are discussed in the following sections of this appendix.

2. Survey Requirements

Existing survey information has been used in the development of this general re-evaluation of the proposed expansion of the Hamilton Wetland Restoration Project. No new complete survey of the BMK parcel was commissioned specifically to support the project reevaluation. It may be necessary to conduct additional surveys of the combined project area and adjacent features, particularly on Novato Creek, as part of the pre-construction, engineering and design phase of the expanded project.

During the period of 1996-97, the Army BRAC office conducted surveys of the Hamilton Airfield area that were utilized for the Feasibility Study of the authorized HWRP. These surveys were conducted by Hunter Surveying, and included aerial photographs, spot elevations, and topographic maps. These surveys have been made available to, and are utilized by the Wetland Restoration design team.

The most recent survey of the BMK-V parcel made available to the project design team was conducted by Tucker& Associates, for Moffatt&Nichol Engineers, as part of study efforts to identify potential environmental mitigation areas for the proposed San Francisco Airport Runway Expansion Project. This survey includes high elevation aerial photographs and Lidar topographic surveys and maps. Please see the attachment D-1 to this appendix, the survey report from Tucker & Associates.

Northwest Hydraulics Corporation (NHC) conducted spot elevation surveys of various key locations on levees bordering the project site, as part of their hydraulic modeling study of the expanded project alternatives. Additional spot elevation surveys of areas of the Novato Creek watershed and adjacent levees, as well as the BMK Lagoon Locks, are planned to support future refined hydraulic modeling efforts.

Note that the National Geodetic Vertical Datum, NGVD, 1929, is used throughout to report elevations of site and design features.

3. Site Work

Prior to construction of project features, dilapidated farm structures will be removed from the site. These wood and sheet metal barn type structures are currently in severe disrepair, and demolition work and removal should not pose any difficulty or significant expense.

The construction contractor may wish to prepare one or more staging areas on the enlarged project site for storage of construction equipment, fuel, dredge pipe, and field office quarters for contractor and Government inspectors use. Preparation of staging areas should not be difficult or expensive given the flat terrain and easy access to the site.

The principal project features requiring site work are discussed in more detail below. Note that, for project planning purposes, the planning window is 50 years, and therefore a 50-year design life guides engineering considerations for levee design and construction.

3.1 Perimeter Levees

Perimeter levees are required along the northwestern perimeter of the BMK expansion site to provide adequate flood protection to the existing Bel Marin Keys Community. Specific geotechnical considerations of levee design and construction are addressed in Appendix C of this report.

The perimeter levees must be designed to provide at least the existing level of flood protection. The levee elevations and side slopes presented here are preliminary design concepts. Final design will require more detailed considerations of the parameters governing necessary levee height and geometry.

The perimeter levee will not be exposed to deep water and large waves over the 50-year life of the enlarged project. Hence a 50-year design elevation of +8.0 feet will provide at least the existing level of flood protection and will be utilized for the expanded project as it was for the authorized HWRP. It is important to note that the levee crest may be initially constructed to an elevation of approximately +10 feet NGVD, subsequently

raised to +10 feet NGVD twice and is estimated to settle to an elevation no less than +8 feet NGVD after 50 years. By that time the wetlands will have reached maturity.

The perimeter levees must satisfy 5 types of performance criteria: settlement, stability, seepage, scour/erosion, and sea-level rise. These criteria, especially stability and settlement, are a challenge for levees constructed on the soils encountered at the BMK-V expansion site because of the thick soft Bay Mud layer underlying the site. The descriptions of the 5 criteria are as follows.

Settlement: - The settlements expected under the loads imposed by the levee and adjacent fill must be considered in the design of the levees, by either constructing the levee to a greater height initially or planning future levee crest elevation construction to account for the settlements, or a combination of the two. For settlement design details, see Appendix C – Geotechnical Design Requirements.

Stability: - The levees must be constructed to have adequate short-term and long-term stability; i.e., they must not fail under expected imposed operating conditions including appropriate seismic loading. For stability design details, see Appendix C – Geotechnical Design Requirements.

Seepage: - Seepage through or under the levee is of concern for the perimeter levee, because it will have a combination of water and dredged material on its "wet" side. It is expected that the levee will be constructed of either dried Bay Mud or imported clayey fill. Hence, through-levee seepage will not be of concern. Existing granular near surface fill from below the main body of the levee (but not below the toe berms) should be excavated, and a keyway (trench filled with new levee fill), about 20 feet wide, should be constructed through the natural clay crust.

Scour/Erosion: - Scouring of the levee face on the bayward side due to wave action and water currents is of concern. The concern is mostly short-term, since after the first few years marsh vegetation will establish on the levee and tidal berms such that water depths adjacent to the levee will be shallow and the wind fetch will be shortened by internal peninsulas and increasing dredged material and sediment depth. Nevertheless, levee slopes expected to be exposed to wave and current action for extended periods of time (i.e., exceeding a few months) should have scour protection. Because scour protection consisting of rock riprap is not acceptable for this project, a High Transitional Marsh is placed alongside the levee and forms a protective berm. Any scour damage will be repaired as a part of levee maintenance.

Sea-Level Rise: - Approximately one half foot of sea-level rise is anticipated over the design life of the structure.

Previous investigations of subsurface conditions and levee construction in the general Hamilton Airfield and BMK- V area were conducted by IT Corporation and Miller-Pacific as indicated in Appendix C – Geotechnical Design Requirements. The conceptual information on levee design and expected performance presented here is based primarily on site-specific information and designs presented in these references. No new site investigations or laboratory tests have been performed for this study. Therefore, the designs developed here are conceptual and must be refined based on additional site-specific information obtained during pre-construction, engineering and design.

The perimeter levees will be constructed using on-site desiccated clay from the Bay Mud "crust." that covers the BMK-V parcel. Suitable dredged material may also be used if ample onsite borrow material is not readily available. The clay will be well compacted during levee construction. On-site borrow material for levee construction is discussed in detail later in paragraph 3.5 below.

3.2 Levee Improvements

Improvements to levees may be required on certain portions of the levee currently containing the BMK south lagoon, as indicated in the restoration alternative figures presented in the main report (See figures 3-1, 3-2, and 3-2 for alternative 1, 2, 3 respectively and figure 4-2 for Revised Alternative 2). The extent of levee improvements and specific remedies will be identified during the PED phase of the expanded project. (See Figure D-2, Improved Levee Structure)

3.3 Dredged Material Containment Cells, Dikes, and Process Water Control

The containment of dredged material on the HAAF and BMK sites during construction is provided by the existing outboard levees and new and existing perimeter levees. Since dredged material placement in the tidal wetland areas may be to a maximum final elevation of +3.5 feet around the site perimeter, all the existing levees have sufficient freeboard to insure dredged material is contained on site prior to breaching the levees and opening the site to tidal action.

The final requirements and design of the dredged material containment cells will be accomplished during the PED phase of the expanded restoration project.

3.4 Internal Peninsulas

A system of internal peninsulas is proposed as part of the site template to: (1) reduce perimeter levee erosion by decreasing internal wave heights, thereby reducing wave run-up; (2) promote rapid sedimentation by limiting internal wave energy and re-suspension of sediments; and (3) constrain the location of tidal sloughs. A gap of approximately 200 feet will be established between the peninsulas and the site perimeter to limit predator access. Internal peninsulas may be constructed to provide a maximum fetch length of approximately 3,000 feet on the expanded project site. A pre-breach peninsula crest

elevation of +5 feet and crest width of 10 feet are preliminarily indicated to reduce internal wave energy during typical storm conditions. The crest height specified provides wave energy dissipation during storm conditions assuming 2-3 feet of inundation and waves. The resulting peninsula cross section is shown on Figure D-2. The peninsulas will be constructed using on-site desiccated clay borrow material. Dredged material may also be used for peninsula construction.

As the marsh matures by natural sedimentation processes, the need for the fetch limiting effect of the peninsulas progressively diminishes. Furthermore, at maturity it is desirable to have a contiguous marsh plain free from isolated elevated features that interfere with natural hydraulic processes and biological continuity. Therefore, the peninsulas will be designed to settle and scour away over time, and thus eventually disappear into the mature marsh plain. The following interior peninsula design criteria are preliminarily suggested.

Settlement: At the end of construction an internal peninsula crest elevation of 5 feet will be needed to accommodate consolidation on the expanded project site. After 50 years of settlement, the crest elevation may drop to about 3 feet.

Stability: Side slopes of 3H:1V and a crest width of 10 feet may provide adequate peninsula stability. Final design may be able to reduce this based on further analysis.

Seepage: Seepage, either through or underneath the peninsulas, is not of concern for the internal peninsulas, because water pressures acting on both sides will be essentially equal.

Scour/Erosion: The internal peninsulas will be subject to scouring action due to tidal flows and waves. Because of the intent for these levees to blend into their surrounding, any additional slope protection that might otherwise be recommended for the prevailing scouring conditions is undesirable. The recommended solution is to use relatively erosion resistant well-compacted soil for the construction of the peninsulas, and to seed them with appropriate native vegetation before the outboard levee is breached. Well-compacted desiccated Bay Mud appears suitable as construction material.

3.5 Borrow Materials

The BMK-V parcel has a surface layer of desiccated Bay Mud that is well suited for construction of levees and other project features. It is anticipated that borrow material may be taken from the top 1 to 2 feet of the surface soil layer. However deeper excavation may be preferable and more efficient over certain portions of the site provided deeper soil layers have adequate material properties for the feature being constructed.

4. Utility Relocation and Infrastructure Requirements

There are no Public Law 91-646 Relocations in this project. There are no utilities being affected by this project that are considered to be relocations as defined in WRDA 1986 and the PCA. The two facilities affected by the BMK-V expansion to the HWRP are the

Novato Sanitary District (NSD) Outfall Pipeline and PG&E high voltage power line towers on the Vaca-Ignacio Line.

The replacement, relocation and/or improvement of the NSD Outfall Pipeline and the associated dechlorination plant are authorized in the existing HWRP. However, in BMK-V Alternatives 1, 2 and 3 the proposed expansion of Pacheco pond will likely require changing the alignment of approximately 2200 feet of the outfall pipeline. This will extend the outfall pipeline by approximately 400 to 500 lineal feet and have an additional cost of approximately $250,000 to 310,000. A NSD Access Berm will be provided as shown in Figure D-2.

These actions are compatible with the currently selected alternatives of replacing the outfall pipeline with a new plastic (HDPE) pipeline within the existing easement and relocating the dechlorination plant to the NSD treatment plants.

Five PG&E high voltage power line towers on the Vaca-Ignacio Line will be affected by all three BMK-V alternatives including one tower near Headquarters Hill on the north western corner of the BMK parcel near Pacheco Pond, and four towers along the northern property boundary adjacent to Novato Creek. The Corps and SCC had experience with towers in similar field conditions and elevations on this same power line during the Sonoma Baylands Project. Based on that experience, only protection of these towers will likely be required. This will include protecting the lower portions of the steel towers with a concrete overlay to prevent corrosion and providing limited access to the towers. The cost of this protection and access is estimated at $500,000 for Alternatives 1 and 2 and $ 600,000 for Alternative 3

5 Dredged Material Quantities, Placement, and Process Water Control

The Bel Marin Keys V (BMK-V) proposed expansion of the Hamilton Wetland Restoration Project (HWRP) is to be constructed utilizing dredged material as fill. It is estimated to require obtaining and placing approximately 24 million cubic yards (MCY) of dredged material in the combined 2,600-acre HWRP and BMK-V expansion project site.

The attached Tables 1-3 reflect the estimated dredge material quantities available considered for both the BMK-V expansion and the HWRP. Table 1 is based upon start of dredged material placement in October 2003. Table 2 is based upon beginning of placement in Spring 2004. Table 3 also depicts beginning of placement in 2004 but additionally has included one million cubic yards of dredged material from the Petaluma River (across the flats channel) Project, which is scheduled for dredging every three years.

The attached Tables 4-7 outline the sequencing of various dredge material placement options for Alternative 1, Revised Alternative 2, and Alternative 3 as described within Chapter 3 of the SEIR/EIS. All of these tables are based upon calendar years.

The dredged material will be conveyed to the restoration site via pipeline from an Off-loading facility located in San Pablo Bay. Current plans for the offshore facility location and potential pipeline alignments are shown in Figure D-3. These plans will be developed further during the PED phase of the HWRP project.

5.1 Dredged Material Supply Quantity

The dredged material for the expanded HWRP will be obtained from Federal Operations & Maintenance (O&M) dredging projects; the Port of Oakland 50 foot Deepening Project, and several suitable non-federal permitted projects in the San Francisco Bay area. Current plans call for the Port of Oakland Deepening Project material to be placed on the HAAF parcel, as authorized in the HWRP feasibility study. However, the availability of the BMK-V parcel will add flexibility to the construction sequence, and provide an alternative beneficial re-use site for this material should outstanding base closure procedures on the HAAF parcel temporarily delay the construction schedule on that portion of the project.

The dredged material from the O&M projects is considered to consist of greater than 75% silts & clay, with the exception of the Pinole Shoal Project, which is estimated to have less than 25% silts and clays. The composition of the 2.5 MCY from the Port of Oakland 50 foot Deepening Project is expected to have 1.8 MCY sand and the rest fine material.

The total estimated dredge material available for the HWRP / BMK-V expansion from 2003 to 2017 is approximately 29 MCY. This is comprised of an estimated 18 MCY to 19 MCY from the Federal O&M Projects, 2.5 MCY from the Port of Oakland Deepening Project and potentially 8 MCY from the suitable, non-federal permitted projects.

The source of the information developed for Tables 1 to 3 is the Moffatt & Nichol Engineers DRAFT Hamilton Off-loader quantity summary report as revised on April 29, 2002. This Moffatt & Nichol report presented estimated quantities of available dredge material from 2002 through 2010. The source of their data input is the Corps' historical project records and the DMMO records of annual dredge quantities removed from applicable projects from 1995 to 2001.

For Tables 1-3 the Moffatt & Nichol information was extended to 2017 using the same frequency and quantity of periodic dredging. Also, the quantities for the Petaluma River (across the flats channel) were not included in the Moffatt & Nichol report and Tables 1 and 2, but are added into Table 3. Based upon a three-year cycle, at an estimated 201,000 CY per dredge episode, from 2003 to 20017 there could be an estimated additional 1 MCY available for placement at the BMK-V and HWRP if this Petaluma material is used. Also, this material should provide good native seed stock for the wetland

restoration. The Moffatt & Nichol estimated periodic dredge quantities have been rounded to the nearest 1,000 cubic yards.

The material shown for the non-federal projects represent material from 7 of the 20 permitted projects considered suitable for the Hamilton Project. This quantity represents approximately 80% of the volume of these medium size permitted projects.

It should be noted that other internal District reports related to HWRP (i.e. Oct 17, 02 – SF Bay Regional DMMP Disposal Cost Estimates) indicate quantities of dredge material for various projects that differ from those indicated in the attached tables. This may be attributable to projections based on quantities of dredged material available and not the actual pay quantity removed. It should be further noted that the estimated dredge quantities and dredging cycle for any given project can vary significantly for a given dredging event due to changes in shoaling, project funding, and other factors.

5.2 Dredged Material Placement Sequence

Tables 4 through 7 outline the preliminary estimates for the dredged material placement sequence options at both BMK-V and HWRP utilizing Alternative 1, 2 & 3 of the BMK-V SEIR. For each of these estimates the BMK-V subdivided areas under the various Alternatives are as shown on the associated plan & section drawings from the SEIR/S).

Table 4, Alternative 1A, reflects beginning of dredged material placement at HWRP in 2004. Table 5, Alternative 1B, reflects beginning of dredged material placement at BMK-V in 2004. Table 6, Revised Alternative 2, presents the dredged material placement for Revised Alternative 2 of the SEIR/S. Finally, Table 7, Alternative 3, presents the estimated sequencing and quantity for Alternative 3 of the SEIR/S.

The Revised Alternative 2 reflects the incorporation of review comments to the Draft SEIR/S and GRR. This includes revisions to internal area acreages and fill elevations. Also included in the Revised Alternative 2 dredge material quantity estimate is an adjustment utilizing a uniform existing site elevation of 5.0 feet below NGVD 1929

5.3 Dredged Material Quantity Adjustments Used

For Alternative 1 & 3 of the preliminary estimate of dredge material quantity required, a material bulking factor of 40% for fine material was used. The estimated self-weight consolidation for the material in a 4 to 5 year period is 15%. The combined material bulking and self weight consolidation factor of the dredged material was estimated to be 25 %. Since the approximate 1 MCY of sandy material from Pinole Shoals was left in the evaluation as fine material the 25% combined bulking and consolidation estimate is considered conservative.

In Alternatives 1& 3 for the areas not subjected to tidal inundation it may be reasonable to consider the volume reduction attributable to a longer period of settlement of 25 or more years. During this period dredge material fills of 5 to 7 feet may settle 1.5 to 2.5 feet. It is therefore considered that the foundation settlement in the non-tidal areas offsets the residual bulking factor of the dredged material. Therefore, no quantity reduction adjustments were made for material to be placed in the non-tidal areas of the proposed site in the results presented in Tables 4, 5, & 7. For the tidal areas however, a conservative approach was taken in assuming dredge fill could not initially exceed an elevation of +2.0 NGVD which limited the maximum potential fill in these areas.

For Revised Alternative 2, an adjustment was made to include the projected 1.0 MCY of sandy material from Pinole Shoal expected and other refinements, resulting in an approximate net material bulking rate used of 35 % instead of the 40% used for Alternatives 1 & 3. The self-weight consolidation was also estimated at 15%. It was also assumed that tidal area fill placement could temporarily exceed + 2.0 elevation. The settlement in the tidal areas used is 1.0 foot which is the expected settlement assumed after 3 years of material placement in tidal areas. This projected settlement together with the self-weight consolation and adjustments made for sandy material from Pinole Shoal is estimated to offset the residual bulking factor of the placed dredged material.

The Tables 4,5 & 7 were developed utilizing a conservative approach relative to maintaining dredge fill below the +2.0 feet NGVD 1929 in the tidal cell areas. Sufficient dredge material quantities are available if there is a requirement for additional material to bring any fill area up to final grade. A detailed design considering all of the various factors associated with determination of actual quantities required will include a detailed recent survey of the site, site foundation analysis, plus material samples and analysis from all potential main sources of dredged material to evaluate more precisely the material characteristics including bulking and consolidation rates.

5.4 Process Water Control

During construction, allowances will need to be made for controlling the process water associated with hydraulic dredged material placement, rainwater, and off-site discharges entering the sites.

The process water control required on the expanded project could vary substantially depending on the type of materials placed in the site (sand vs. fine-grained) and if the site is de-watered with pumps or allowed to pond to inter-tidal levels and drained through weirs. If large quantities of sandy materials were to be placed on interior portions of the site, it would be preferable to keep the site dewatered with temporary ditches and pumps during these activities to allow site access. If predominantly fine-grained materials are placed into the site, interior site access may not be required and ponding to inter-tidal levels and dewatering with weirs would be the cost effective option. Ponding to inter-tidal levels may also be preferable to keep the material in a saturated condition. Water

quality control is not expected to be a problem on these sites for sandy or fine-grained fills.

If pumping is the required or preferred method to dewater the site, the pumps should be specified, supplied, operated, and maintained by the contractor filling the site. The construction contract should clearly indicate the nature and variability of rain and off-site discharges into the site and make the management of those waters the contractor's responsibility.

If significant quantities of fine-grained materials are placed and the site is de-watered by pumps it may be desirable to have a sediment settling basin to control turbidity and provide temporary storage for process water or other waters. For both sites, a sediment settling basin could be placed near the future levee breach area, a location where no fill is required. These basins would typically be constructed with a low dike of native materials with a crest elevation 1 to 2 feet above the preferred water ponding elevation. Water would enter these areas through weirs in the dike.

If the site is to be drained by weirs they should be designed to accommodate significant storm water flows as well as the expected process water quantities It must be noted that storm conditions in this area are frequently accompanied by high tides, storm surges, and wind wave conditions that may severely limit or preclude dewatering the site by gravity. Recently, conditions of this type have persisted for a week or more. If weirs are used to dewater the site the sediment settling basins would not be a necessary project feature and would be expensive to construct due to the cost of building a dike for this basin to above inter-tidal elevations.

When fine-grained fill is hydraulically placed into the tidal wetland restoration areas on the combined Hamilton and BMK expanded site, it will be low-density fluid mud. Prior to breaching the levees and restoring tidal action to these sites, the material will require time to consolidate. Similar projects have allowed approximately 6-12 months for this consolidation. During this consolidation period, the material typically remains inundated to preclude chemistry changes that could be detrimental to wetland habitat. The dredged material may be placed to a maximum final elevation of +2 feet NGVD in these areas and the water level during consolidation should remain slightly above the material surface. Therefore, assuming the template is fully constructed, the maximum water elevation in the site during the consolidation period would be approximately +3 feet NGVD.

6. Construction Schedule

For the authorized HWRP (without BMK-V), the current construction schedule is for site preparation construction to start in FY-2003 or early FY-2004. Initial dredged material placement is scheduled to start in FY-2004. Site preparation will continue on sequential portions of the site during dredged material placement. Dredged material placement will likely be completed in FY-2008. All site construction, including levee breaches and tidal

channel construction should be complete by FY-2010. For the combined HWRP and BMK-V project the proposed construction sequence is to complete all dredged material placement at the Hamilton Airfield and then begin dredged material placement at the BMK-V site, including the State Lands Commission Parcel.

For the combined project the proposed construction schedule is for site preparation construction to start in FY-2003 or early FY-2004 at the Hamilton Airfield. Initial dredged material placement is proposed to begin at the Hamilton Airfield in FY-2004 and continue through FY-2006. Site preparation construction at the BMK-V site would likely begin in FY-2004 or 2005. Initial dredged material placement is proposed to begin at the BMK-V site in FY-2007 and continue through FY-2015. Each of the tidal wetlands restoration areas would likely have the levee breach and tidal channel construction complete within two years after the final placement of dredged material. All site construction would likely be complete by FY-2016 to 2018. All tidal wetlands restoration areas will able to be breached within eight years of site preparation.

In the event that the Hamilton Airfield (BRAC) parcel or the State Lands Commission (FUDS) parcel are not ready for restoration construction on the schedule proposed above, construction on the BMK-V site could begin earlier. Construction on the BRAC and FUDS parcels could then begin at any convenient time up to about FY-2009 or 2010.

BMKV EXPANSION BOUNDARY
PROPOSED

HAMILTON WETLANDS RESTORATION PROJECT
EXISTING

SOURCE OF ELEVATION INFORMATION: JONES & STOKES, INC.

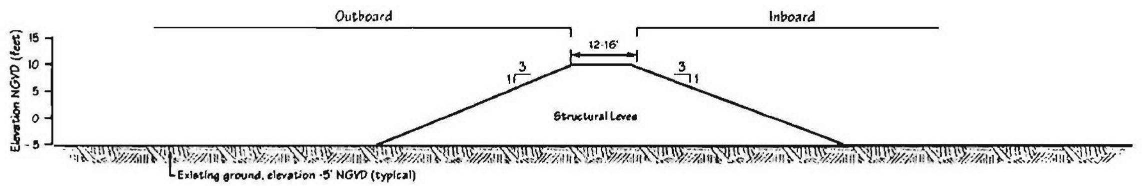
HAMILTON WETLANDS
RESTORATION PROJECT

FIGURE-D-1

Figure D-2
Typical New and Improved Levee Cross Sections – Revised Alternative 2

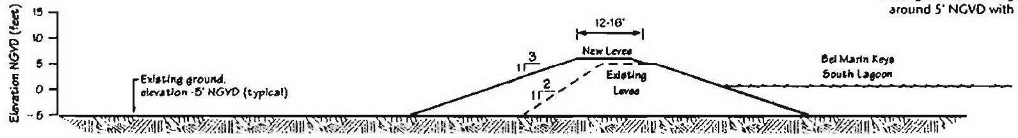
New Levee Structure

100-year tide ~ 6.5' NGVD[a]
MHHW ~ 3.0 to 4.0' NGVD
2 foot settlement to design height of 8' NGVD

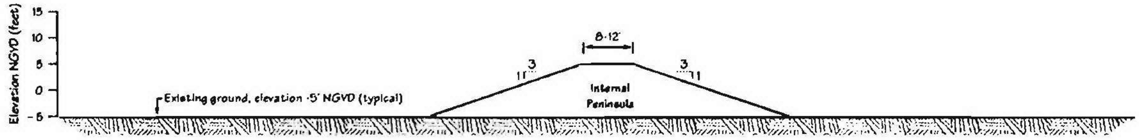


Improved Levee Structure

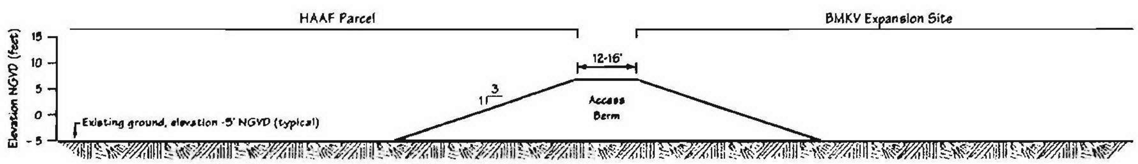
1 foot settlement to design height of 5' NGVD
Existing BMK South Lagoon levee is mostly at elevations around 5' NGVD with several low points around 2–3' NGVD.



Internal Peninsulas



Novato Sanitary District Access Berm[b, c, d]



Notes:

[a] The 100-year tide is based on an estimate of 6.5 feet NGVD by the USACE (1984). For design purposes, this has been adjusted upward to 7 feet to account for the effects of a number of factors: mean sea level rise; wind-induced set-up within San Pablo Bay; wave runup on the adjacent mudflat; flood runoff from the Sacramento-San Joaquin Delta; and uncertainties in the estimation methods (U.S. Army Corps of Engineers 1998).

[b] Under Revised Alternative 2, access will be provided by the new levee constructed along the southern perimeter of the seasonal wetland habitat area and the access berm.

[c] Under Alternative 3, an intertidal bench will be constructed along the northern side of the access berm adjacent to the BMKV Expansion Site.

[d] The height of the access berm would be between 4 and 6 feet. Under Revised Alternative 2, the portion of the access berm adjacent to the seasonal wetland area at BMKV will be 7 feet.

Jones & Stokes   nhc

TABLE 1

PREDICTED DREDGE MATERIAL AVAILABILITY 2003 -2017 FOR:
HAMILTON WETLANDS RESTORATION PROJECT - BEL MARIN KEYS V EXPANSION

Assumes material placement starts in 2003

	CALENDAR YEARS															
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	TOTAL
FEDERAL O&M PROJECTS																	
Oakland Harbor[1]	0	0	436,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	5,662,000
Pinole Shoals[1]	0	198,000	0	198,000	0	198,000	0	198,000	0	198,000	0	198,000	0	198,000	0	0	1,386,000
Redwood City Harbor[1]	0	0	0	432,000	0	0	432,000	0	0	432,000	0	0	432,000	0	0	432,000	2,160,000
Richmond Harbor[1]	0	380,000	380,000	380,000	380,000	380,000	380,000	380,000	380,000	380,000	380,000	384,000	384,000	384,000	384,000	384,000	5,720,000
Richmond Harbor - Long Wharf and Southampton Shoals	0	0	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	3,850,000
TOTAL	0	578,000	1,091,000	1,687,000	1,057,000	1,255,000	1,489,000	1,255,000	1,057,000	1,687,000	1,057,000	1,259,000	1,493,000	1,259,000	1,061,000	1,493,000	18,778,000
RUNNING TOTAL	0	578,000	1,669,000	3,356,000	4,413,000	5,668,000	7,157,000	8,412,000	9,469,000	11,156,000	12,213,000	13,472,000	14,965,000	16,224,000	17,285,000	18,778,000	
NON-FEDERAL PROJECTS																	
Chevron	0	0	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	1,680,000
Larkspur Ferry Channel[2]	0	245,000	0	245,000	0	245,000	0	245,000	0	245,000	0	245,000	0	245,000	0	245,000	1,960,000
Port of Oakland[3]	0	0	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	1,260,000
Port of Redwood City	0	0	21,000	0	0	21,000	0	0	21,000	0	0	21,000	0	0	21,000	0	105,000
Port of San Francisco[4]	0	0	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	2,492,000
Port of Richmond (Berths)[5]	0	0	0	50,000	0	0	50,000	0	0	50,000	0	0	50,000	0	0	50,000	250,000
Tosco/Unical	0	0	0	65,000	0	65,000	0	65,000	0	65,000	0	65,000	0	65,000	0	65,000	455,000
TOTAL	0	245,000	409,000	748,000	388,000	719,000	438,000	698,000	409,000	748,000	388,000	719,000	438,000	698,000	409,000	748,000	8,202,000
RUNNING TOTAL	0	245,000	654,000	1,402,000	1,790,000	2,509,000	2,947,000	3,645,000	4,054,000	4,802,000	5,190,000	5,909,000	6,347,000	7,045,000	7,454,000	8,202,000	
FEDERAL NEW WORK																	
Oakland -50' Deepening[1]	0	0		1,000,000	1,500,000	0	0	0	0	0	0	0	0	0	0	0	2,500,000
TOTAL	0	0	0	1,000,000	1,500,000	0	0	0	0	0	0	0	0	0	0	0	2,500,000
RUNNING TOTAL	0	0	0	1,000,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000
ANNUAL TOTAL	0	823,000	1,500,000	3,435,000	2,945,000	1,974,000	1,927,000	1,953,000	1,466,000	2,435,000	1,445,000	1,978,000	1,931,000	1,957,000	1,470,000	2,241,000	29,480,000
ANNUAL RUNNING TOTAL	0	823,000	2,323,000	5,758,000	8,703,000	10,677,000	12,604,000	14,557,000	16,023,000	18,458,000	19,903,000	21,881,000	23,812,000	25,769,000	27,239,000	29,480,000	

Note: Table information from the Moffatt & Nichol Engineers report of estimated dredge quantities available from 2002 to 2010 as revised April 29, 2002. This information was used to extend period to 2017. Also, footnotes 6&7 added.

[1] Dredge predictions based upon Corps historical & DMMO records.
[2] Larkspur Ferry Channel historical data does not show recognizable trend.
[3] Port of Oakland prediction based on DMMO information.
[4] Port of San Francisco prediction based on DMMO information.
[5] Port of Richmond historical data does not show recognizable trend. Loose prediction. No reported dredging in 2001, some material went to uplands, but not included in Corps historical data records.
6 Table depicts estimated commencement of material placement at Hamilton in 4th quarter of 2003.
7 The Non-Federal projects shown represent approximately 80% of the volume of the medium size in-bay permitted projects.

TABLE 2

PREDICTED DREDGE MATERIAL AVAILABILITY 2004 - 2017 FOR: HAMILTON WETLANDS RESTORATION PROJECT - BEL MARIN KEYS V EXPANSION

Assumes material placement starts in 2004

	CALENDAR YEARS																
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	TOTAL
FEDERAL O&M PROJECTS																	
Oakland Harbor[1]	0	0	436,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	5,662,000
Pinole Shoals[1]	0	0	0	198,000	0	198,000	0	198,000	0	198,000	0	198,000	0	198,000	0	198,000	1,388,000
Redwood City Harbor[1]	0	0	0	432,000	0	0	432,000	0	0	432,000	0	0	432,000	0	0	0	1,728,000
Richmond Harbor[1]	0	0	380,000	380,000	380,000	380,000	380,000	380,000	380,000	380,000	380,000	384,000	384,000	384,000	384,000	384,000	5,340,000
Richmond Harbor - Long Wharf and Southampton Shoals	0	0	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	3,850,000
TOTAL	0	0	1,091,000	1,687,000	1,057,000	1,255,000	1,489,000	1,255,000	1,057,000	1,687,000	1,057,000	1,259,000	1,493,000	1,259,000	1,061,000	1,259,000	17,966,000
RUNNING TOTAL	0	0	1,091,000	2,778,000	3,835,000	5,090,000	6,579,000	7,834,000	8,891,000	10,578,000	11,635,000	12,894,000	14,387,000	15,646,000	16,707,000	17,966,000	
NON-FEDERAL PROJECTS																	
Chevron	0	0	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	1,680,000
Larkspur Ferry Channel[2]	0	0	0	245,000	0	245,000	0	245,000	0	245,000	0	245,000	0	245,000	0	245,000	1,715,000
Port of Oakland[3]	0	0	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	1,260,000
Port of Redwood City	0	0	21,000	0	0	21,000	0	0	21,000	0	0	21,000	0	0	21,000	0	105,000
Port of San Francisco[4]	0	0	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	2,492,000
Port of Richmond (Berths)[5]	0	0	0	50,000	0	0	50,000	0	0	50,000	0	0	50,000	0	0	50,000	250,000
Tosco/Unical	0		0	65,000	0	65,000	0	65,000	0	65,000	0	65,000	0	65,000	0	65,000	455,000
TOTAL	0	0	409,000	748,000	388,000	719,000	438,000	698,000	409,000	748,000	388,000	719,000	438,000	698,000	409,000	748,000	7,957,000
RUNNING TOTAL	0	0	409,000	1,157,000	1,545,000	2,264,000	2,702,000	3,400,000	3,809,000	4,557,000	4,945,000	5,664,000	6,102,000	6,800,000	7,209,000	7,957,000	
FEDERAL NEW WORK PROJECTS																	
Oakland -50' Deepening[1]	0	0	0	1,000,000	1,500,000	0	0	0	0	0	0	0	0	0	0	0	2,500,000
TOTAL	0	0	0	1,000,000	1,500,000	0	0	0	0	0	0	0	0	0	0	0	2,500,000
RUNNING TOTAL	0	0	0	1,000,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000
ANNUAL TOTAL	0	0	1,500,000	3,435,000	2,945,000	1,974,000	1,927,000	1,953,000	1,466,000	2,435,000	1,445,000	1,978,000	1,931,000	1,957,000	1,470,000	2,007,000	28,423,000
ANNUAL RUNNING TOTAL	0	0	1,500,000	4,935,000	7,880,000	9,854,000	11,781,000	13,734,000	15,200,000	17,635,000	19,080,000	21,058,000	22,989,000	24,946,000	26,416,000	28,423,000	

Note: Table information from the revised Moffatt & Nichol Engineers report of estimated dredge quantities available from 2002 to 2010 submitted April 29, 2002. Table extended to 2017 utilizing this information. Also, footnotes 6 & 7 added.

[1]Dredge predictions provided by USACE in scope
[2]Larkspur Ferry Channel historical data does not show recognizable trend. VERY Loose prediction.
[3]Port of Oakland DMMO data largely conflicts with scope data. Prediction based on DMMO information.
[4]Port of San Francisco DMMO data largely conflicts with scope data. Prediction based on DMMO information.
[5]Port of Richmond historical data does not show recognizable trend. Loose prediction. No reported dredging in 2001, some material went to uplands, not reported to Corps.
6Table depicts estimated commencement of material placement of material at HWRP / BMKV in 4th quarter of 2003.
7The Non-Federal projects shown represent approximately 80% of the volume of the medium size in-bay projects.

10/11/02

TABLE 3 -

PREDICTED DREDGE MATERIAL AVAILABILITY 2004 -2017:
HWRP - BMKV Expansion
with Petaluma River Channel Across Flats

Assumes begin material placement in 2004

	CALENDAR YEAR																
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	TOTAL
FEDERAL O&M PROJECTS																	
Oakland Harbor[1]	0	0	436,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	402,000	5,662,000
Pinole Shoals[1]	0	0	0	198,000	0	198,000	0	198,000	0	198,000	0	198,000	0	198,000	0	198,000	1,386,000
Redwood City Harbor[1]	0	0	0	432,000	0	0	432,000	0	0	432,000	0	0	432,000	0	0	432,000	2,160,000
Richmond Harbor[1]	0	0	380,000	380,000	380,000	380,000	380,000	380,000	380,000	380,000	380,000	380,000	380,000	380,000	380,000	380,000	5,320,000
Richmond Harbor - Long Wharf and Southampton Shoals	0	0	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	275,000	3,850,000
Petaluma R. (across flats) Channel				201,000			201,000			201,000			201,000			201,000	1,005,000
TOTAL	0	0	1,091,000	1,888,000	1,057,000	1,255,000	1,690,000	1,255,000	1,057,000	1,888,000	1,057,000	1,255,000	1,690,000	1,255,000	1,057,000	1,888,000	19,383,000
RUNNING TOTAL	0	0	1,091,000	2,979,000	4,036,000	5,291,000	6,981,000	8,236,000	9,293,000	11,181,000	12,238,000	13,493,000	15,183,000	16,438,000	17,495,000	19,383,000	
NON-FEDERAL PROJECTS																	
Chevron	0	0	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	1,680,000
Larkspur Ferry Channel[2]	0	0	0	245,000	0	245,000	0	245,000	0	245,000	0	245,000	0	245,000	0	245,000	1,715,000
Port of Oakland[3]	0	0	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	90,000	1,260,000
Port of Redwood City	0	0	21,000	0	0	21,000	0	0	21,000	0	0	21,000	0	0	21,000	0	105,000
Port of San Francisco[4]	0	0	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	178,000	2,492,000
Port of Richmond (Berths)[5]	0	0	0	50,000	0	0	50,000	0	0	50,000	0	0	50,000	0	0	50,000	250,000
Tosco/Unical	0	0	0	65,000	0	65,000	0	65,000	0	65,000	0	65,000	0	65,000	0	65,000	455,000
TOTAL	0	0	409,000	748,000	388,000	719,000	438,000	698,000	409,000	748,000	388,000	719,000	438,000	698,000	409,000	748,000	7,957,000
RUNNING TOTAL	0	0	409,000	1,157,000	1,545,000	2,264,000	2,702,000	3,400,000	3,809,000	4,557,000	4,945,000	5,664,000	6,102,000	6,800,000	7,209,000	7,957,000	
FEDERAL NEW WORK																	
Oakland -50' Deepening[1]	0	0	0	1,000,000	1,500,000	0	0	0	0	0	0	0	0	0	0	0	2,500,000
TOTAL	0	0	0	1,000,000	1,500,000	0	0	0	0	0	0	0	0	0	0	0	2,500,000
RUNNING TOTAL	0	0	0	1,000,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000
ANNUAL TOTAL	0	0	1,500,000	3,636,000	2,945,000	1,974,000	2,128,000	1,953,000	1,466,000	2,636,000	1,445,000	1,974,000	2,128,000	1,953,000	1,466,000	2,636,000	29,840,000
ANNUAL RUNNING TOTAL	0	0	1,500,000	5,136,000	8,081,000	10,055,000	12,183,000	14,136,000	15,602,000	18,238,000	19,683,000	21,657,000	23,785,000	25,738,000	27,204,000	29,840,000	

Note: Table information from the revised Moffatt & Nichol Engineers report of estimated dredge quantities available from 2002 to 2010 submitted April 29,2002. This information was utilized to extend table to 2017. Also, footnotes 6, 7 & 8 added.

[1]Dredge predictions provided by USACE in scope

[2]Larkspur Ferry Channel historical data does not show recognizable trend. VERY Loose prediction.

[3]Port of Oakland DMMO data largely conflicts with scope data. Prediction based on DMMO information.

[4]Port of San Francisco DMMO data largely conflicts with scope data. Prediction based on DMMO information.

[5]Port of Richmond historical data does not show recognizable trend. Loose prediction. No reported dredging in 2001, some material went to uplands, not reported to Corps.

6 Table includes material from Petaluma River (across the flats) Channel.

7 Table depicts estimated commencement of material placement in 2004.

8 The Non-Federal projects shown represent approximately 80% of the volume of the medium in-bay permitted projects.

TABLE 4 - Alternative 1

Scenario A

HAMILTON WETLAND RESTORATION PROJECT - BEL MARIN KEYS V EXPANSION
DREDGED MATERIAL PLACEMENT ESTIMATES
Placement begins at Hamilton Site in 2004

AREA (Listed in order of fill)	Acres	Avg. Existing Elevation	Material Fill Elevation	Average Fill Depth	Volume MCY	Total estimated insitu dredge quantity required MCY	Cummulative Quantity MCY	Potential Year Filled
1. Hamilton Tidal	400				5	5.0	5.0	2004-2006
2. Hamilton Seasonal (Panhandle / Southeast)	136				1.8	1.8	6.8	2006
					0.1	0.1	6.9	2006
Subtotal:	**536**				**6.9**	**6.9**		
3. BMK Seasonal								
Upland Transition	296	-4.5	+4.0	8.5	4.1	4.1	11.0	2006-2008
Seasonal Wetlands	37	-4.5	0	4.5	0.3	0.3	11.3	2008
FW Emergent Wetlands	11	-4.0	0	0.0	0			
High Transitional Marsh	144	-4.5	3.5	8.0	1.9	1.9	13.2	2008-2009
Open Water (Pacheco Pond Expansion)	40							
Miscellaneous Areas (3.5%)	63							
4. BMK Tidal - North Cell	389	-4.8	+2.0 to 0	5.8	3.6	3.3	16.5	2009-2011
5. BMK Tidal - Center Cell	346	-4.8	+2.0 to 0	5.8	3.2	3.0	19.5	2011-2013
6A. BMK Tidal - South Cell (with 127 A of SLC)	377	-4.8	+2.0-to 0	5.8	3.5	3.2	22.7	2013-2014
6B. Mid-high tidal (90 A of SLC)	90	-5.0	+3.5	8.5	1.2	1.1	23.8	2014-2015
Subtotal BMK w/ SLC:	**1,793**				**17.8**	**16.9**		
Totals:	**2,329**				**24.7**	**23.8**		

NOTES:

Elevation Datum Ref. NGVD 29

Total Hamilton: 644 Acres (without SLC)

BMK V 1,576

SLC 319 (217 A within Project - balance in outboard marsh)

Estimated factors for quantity adjustment include:

For this analysis most of the dredge material with the exception of 1.8 MCY from Oakland assumed to be fine grain material.

Short term material bulking & self weight consolidation is 25-30%

Short term foundation settlement (4-5 years) is 0.5 to 1.5 feet in areas with bay mud depths of 50 to 60 feet.

Long term settlements (25-35 years) approximately 2 to 2.5 feet.

Areas subject to tidal inflow will be filled to elevation 2.0 feet NGVD 29 and attain final grade from natural sedimentation.

TABLE 5 - Alternative 1

HAMILTON WETLAND RESTORATION PROJECT - BEL MARIN KEYS V EXPANSION
DREDGED MATERIAL PLACEMENT ESTIMATES
Placement begins at Bel Marin Keys V Site in 2004

Scenario B

AREA (Listed in order of fill)	Acres	Avg. Existing Elevation	Material Fill Elevation	Average Fill Depth	Volume MCY	Total estimated insitu dredge quantity required MCY	Cummulative Quantity MCY	Potential Year Filled
1. BMK Seasonal								
Upland Transition	296	-4.5	+4.0	8.5	4.1	4.1	4.1	2004-2005
Seasonal Wetlands	37	-4.5	0	4.5	0.3	0.3	4.4	2005
FW Emergent Wetlands	11	-4.0	0	0.0	0			
High Transitional Marsh	144	-4.5	3.5	8.0	1.9	1.9	6.3	2005-2006
Open Water (Pacheco Pond Expansion)	40			0	0	0		
Miscellaneous Areas (3.5%)	63							
2. BMK Tidal - North Cell	389	-4.8	+2.0 to 0	5.8	3.6	3.3	9.6	2006-2007
3. BMK Tidal - Center Cell	346	-4.8	+2.0 to 0	5.8	3.2	3.0	12.6	2007-2009
Subtotal:	**1326**				**13.1**	**12.6**		
4. Hamilton Tidal	400				5	5.0	17.6	2009-2011
5. Hamilton Seasonal (Panhandle / Southeast)	136				1.8	1.8	19.4	2012-2013
					0.1	0.1	19.5	2013
Subtotal:	**536**				**6.9**	**6.9**		
6A. BMK Tidal - South Cell (with 127 A of SLC)	377	-4.8	+2.0 to 0	5.8	3.5	3.2	22.7	2013-2014
6B. Mid-high tidal (90 A of SLC)	90	-5.0	+3.5	8.5	1.2	1.1	23.8	2014-2015
Subtotal BMK w/ SLC:	**467**				**4.7**	**4.3**		
Totals:	**2,329**				**24.7**	**23.8**		

NOTES:
Elevation Datum Ref. NGVD 29

Total Hamilton: 644 Acres (without SLC)
BMK V 1,576
SLC 319 (217 A within Project - balance in outboard marsh)

Estimated factors for quantity adjustment include:
- For this analysis most dredge material with exception of 1.8MCY from Oakland assumed to be fine grain material.
- Short term material bulking & self weight consolidation results in estimated net volume increase of 25-30%
- Short term foundation settlement (4-5 years) is 0.5 to 1.5 feet in areas with bay mud depths of 50 to 60 feet.
- Long term settlements (25-35 years) approximately 2 to 2.5 feet.
- Areas subject to tidal inflow will be filled to elevation 2.0 feet NGVD 29 and attain final grade from natural sedimentation.

TABLE 6 -
Revised Alternative 2

HAMILTON WETLAND RESTORATION PROJECT - BEL MARIN KEYS V EXPANSION
DREDGED MATERIAL PLACEMENT ESTIMATES

AREA	Acres	Avg. Existing Elevation	Material Fill Elevation	Average Fill Depth(Ft)	Available Volume MCY	Total estimated Insitu dredge quantity required MCY	Cummulative Quantity MCY	Potential Year Filled
1. Hamilton Tidal	400				5.0	5.0	5.0	2004-2006
2. Hamilton Seasonal Wetland	152				2.1	2.1	2.1	2006
Subtotal:	**552**				**7.1**	**7.1**	7.1	
3. BMK								
Upland Transition	247	-5.0	0 to +1.5	5.75	2.3	2.3	9.4	2006-2007
Open Water	21	0.0	NA	NA	0	0.0		
Fresh Water Emergent Wetlands	12	-5.0	-5.0 to -2.0	1.50	0.1	0.1	9.5	2007
Seasonal Wetlands	277	-5.0	-1.5 to 0.0	4.25	1.9	1.9	11.4	2007-2008
High Transitional Marsh	79	-5.0	+3.5	8.50	1.1	1.1	12.5	2008-2009
Tidal Marsh	940	-5.0	0 to +2.0	6.00	9.1	9.1	21.6	2009-2013
(Incl.low marsh, tidal & subtidal)								
Subtotal BMK	**1,576**				**14.5**	**14.5**		
4. SLC								
Tidal	152	-5.0	0 to +2.0	6.0	1.5	1.5	23.1	2013-2014
High Transition	93	-5.0	+3.5	8.5	1.3	1.3	24.4	2015
Subtotal SLC	**245**				**2.8**	**2.8**		
Grand Total:	**2,373**				**24.4**	**24.4**		

NOTES:
Elevation Datum Ref. NGVD 1929

Estimated factors for dredge fill quantity adjustment include:
For this analysis most of the dredge material, with the exception of 1.8 MCY sand from Oakland & 1.3 MCY sand from Pinole Shoal O&M, is assumed to be fine grain material.
Short term foundation settlement (4-5 years) averaged 1.0 foot in areas with bay mud depths of 50 to 60 feet.
Tidal area placement cells can have short term initial fill elevation exceeding final fill elevation of 0 to +2.0 feet.
Areas subject to tidal inflow will attain final grade from natural sedimentation.

TABLE 7 - Alternative 3

HAMILTON WETLAND RESTORATION PROJECT - BEL MARIN KEYS V EXPANSION
MATERIAL PLACEMENT ESTIMATES
Commencement of Placement at Hamilton Site in 2004

AREA (Listed in order of fill)	Acres	Avg. Existing Elevation	Material Fill Elevation	Average Fill Depth	Volume MCY	Total estimated insitu dredge quantity required MCY	Cummulative Quantity MCY	Potential Year Filled
1. Hamilton Tidal	400				5.0	5.0	5.0	2004-2006
2. Hamilton Seasonal (Panhandle / Southeast)	136				1.8	1.8	6.8	2005-2006
					0.1	0.1	6.9	2006
Subtotal:	**536**				**6.9**	**6.9**		
3. BMK Mid-high tidal (90 A of SLC)	90	-5.0	+3.5	8.5	1.2	1.1	8.0	2006-2007
Subtotal BMK w/ SLC:	**90**				**1.2**	**1.1**		
Totals:	**626**				**8.1**	**8.0**		

NOTES:

Elevation Datum Ref. NGVD 29

Total Hamilton: 644 Acres (without SLC)
BMK V 1,576
SLC 319 (217 A within Project - balance in outboard marsh)

Estimated factors for quantity adjustment include:
For this preliminary analysis most of the dredge material with the exception of 1.8 MCY from Oakland assumed to be fine grain material
Short term material bulking & self weight consolidation is 25-30%
Short term foundation settlement (4-5 years) is 0.5 to 1.5 feet in areas with bay mud depths of 50 to 60 feet.
Areas subject to tidal inflow will be filled to elevation 2.0 feet NGVD 29 and attain final grade from natural sedimentation.

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June 6, 2001

Survey Report

Hamilton Field area and Napa Crystallizers
Topographical Data Collection

Tucker & Associates was contracted to provide topographical information on the two sites to an accuracy level that could provide one foot contours with a horizontal positional accuracy of approximately two feet.

Due to the combined size of the two sites and access problems, as well as cost analysis, it was determined that LIDAR (Light Amplification And Ranging) techniques would be the best solution. This method of topographical data gathering involves transmitting Laser pulses in a very dense grid (about three feet) from an aircraft that is equipped with Global Positioning System (GPS) equipment. We contracted Airborne1, based out of Los Angeles, CA. to perform the Scanning. They utilize an Optech ALTM 1225 Lidar Scanner which in addition to the GPS equipment, has an Inertial Measurement Unit (IMU) incorporated into the system. At the same time as the aircraft is performing the Lidar Scan, a GPS receiver is set up on a High Accuracy Reference Network (HARN) station and the two receivers (aircraft and ground) log measurements to the same satellites for post-processing to determine the position of the LIDAR Scanner during the operation.
The GPS positions are integrated with the IMU data to determine the precise positions of the Scanner during the flight. These positions have a typical accuracy of plus or minus 10 to 15 centimeters.

Combining the HARN station 3-dimensional coordinates with the Base station GPS data and the LIDAR Scan information- results in a DTM (Digital Terrain Model) of the sites. The DTM is then checked by a process known as "ground truthing"- this consists of performing a series of dynamic GPS profiles, optimally transverse to the direction of the scans, to an accuracy of +/- 3 cm horizontally and +/- 5 cm vertically; and comparing the DTM values to the profile points.

A summary of the results of the comparisons is as follows:

Site	Standard deviation (one sigma)	RMS
Marin	0.28'	0.37'
Napa	0.21'	0.22'

Color aerial photographs of the sites were taken and rectified to USGS "Quad" control, and transformed to digital Geotiff format to serve as a "backdrop" for the plotted one foot contour maps which were compiled from the DTM.

In addition to the Hardcopy plots, digital drawing (DWG) files were generated along with a 5' grid Ascii file of each site and raw data files (bald earth and vegetation).

Prepared by:

Thomas J. Tucker, PLS # 4460

June 5, 2001

HAMILTON WETLANDS
RESTORATION PROJECT

Appendix E

Hydrology and Hydraulics Analysis

Appendix E
Hydrology and Hydraulic Engineering Considerations

1. Regional Hydrology

1.1 Climate

The project site and the surrounding area are characterized by a Mediterranean climate with warm, dry summers and cool, wet winters (California Coastal Conservancy and U.S. Army Corps of Engineers 1998). The climate is strongly influenced by conditions in San Francisco Bay and, to a lesser extent, the Pacific Ocean. July is typically the warmest month, with a mean daytime temperature of approximately 80° F. January is the coldest month, with a mean daytime temperature of approximately 54° F. Differences in minimum and maximum daily temperatures are approximately 30° F in the summer months and 15–20° F in the winter (U.S. Army Corps of Engineers 1987).

Precipitation near the project site ranges from approximately 22 to 30 inches per year, with 90% falling between the months of November and April (U.S. Army Corps of Engineers 1987), primarily in the form of rain. Even in the upper watersheds, snowfall is rare, and snowmelt does not contribute significantly to runoff (Jones & Stokes 2001).

Wind direction frequency plots show a uniform directional distribution. The highest mean wind speeds originate from the northwest (10.4 mph) and southeast (8.8 mph) (California Coastal Conservancy and U.S. Army Corps of Engineers 1998).

1.2 Tides

Tides in San Pablo Bay follow a mixed semidiurnal cycle, with 2 high tides of unequal elevation and 2 low tides of unequal elevation per day. Average high tide elevation values are referred to as *mean higher high water* (MHHW) and *mean high water* (MHW). Similarly, low tide peaks are referred to as *mean low water* (MLW) and *mean lower low water* (MLLW). Events such as storm high tides that exceed the elevation of MHHW are referred to as *extreme high tide* (EHT).

Because of geographic and hydrodynamic complexities, tidal characteristics, including the elevations of average high, low, and mean tides, differ substantially throughout the San Francisco Bay–San Pablo Bay system. Tide cycles in San Pablo Bay typically lag behind those at the Golden Gate by as much as 75 minutes (U.S. Army Corps of Engineers 1996). However, within San Pablo Bay itself, comparison of tide levels within Novato Creek and those observed at the mouth of the Petaluma River indicates that the lag time is negligible between these sites (Philip Williams & Associates 1998).

Table 2-2 shows statistical tidal information for the project site, obtained from measurements made by NOAA/NOS at the mouth of the Petaluma River (Tide Gage #941 5252) (NOAA/NOS 1981). Table 2-2 also shows the expected elevation of a 100-

year tide in San Pablo Bay. The 100-year tide represents a tide that has a 1 in 100 chance of occurring in any given year.

Note that NOAA is currently working on refinements to tidal datum information for this specific project site.

Table E-1. Tide Information from the Petaluma River Entrance

Tide Level	Feet above MLLW Datum	Feet above NGVD 29 Datum
100-year Event (SF COE)[1]	9.63	7.00
Mean Higher High Water (MHHW)[2]	6.06	3.43
Mean High Water (MHW)[2]	5.49	2.86
Mean Tide Level (MTL)[2]	3.24	0.61
NGVD 1929[2]	2.63	0.00
Mean Low Water (MLW)[2]	1.00	-1.63
Mean Lower Low Water (MLLW)[2]	0.00	-2.63

Sources: U.S. Army Corps of Engineers, 1994 (1), NOAA/NOS, 1981 (2)

Tide data recently collected by San Francisco International Airport's Airfield Development Engineering Consultant (2000) at the mouth of the Petaluma River correspond closely to the NOAA/NOS data shown in Table E-1. The ADEC data consist of water surface measurements taken at 10-minute intervals over a 30-day period from June 15, 2001 to July 15, 2001. The MHW computed from the ADEC dataset is 0.14 feet below the value reported by NOAA; the MLW computed from the ADEC dataset is 0.07 feet above the value reported by NOAA.

1.3 Surface Water Drainage Patterns

The project site is located in a watershed bounded by the hills of central and northern Marin County (a portion of the California Coast Ranges) to the west and by San Pablo Bay to the east (see Figure 2-1). The upland areas have elevations of 1300–1600 feet NGVD 29 and support mixed open grasslands, oak woodlands, and chaparral (California Coastal Conservancy and U.S. Army Corps of Engineers 1998). The lowlands have elevations as low as several meters below mean tide level (MTL) and consist of agricultural fields that were reclaimed from the Bay by levee in the late 1800s.

In the San Francisco Bay region, the permeability of both soils and underlying bedrock is typically low. As a result, infiltration rates are slow, runoff rates are correspondingly high and strongly dependent on precipitation, and base flow is poorly sustained. Most streams are ephemeral (Jones & Stokes 2001).

Major site features on and near the project site are described in the following sections.

1.4 Pacheco Creek

Pacheco Creek drains a watershed of approximately 1.9 square miles. It originates 3 miles west of Hamilton Army Airfield on Big Rock Ridge, crosses several roadways, including U.S. Highway 101, via culverts, and discharges into Pacheco Pond (California Coastal Conservancy and U.S. Army Corps of Engineers 1998). Hydrologic studies completed for the Hamilton Airfield wetland restoration plan estimated the 10-year and 100-year discharges entering Pacheco Pond at 582 and 1,041 cubic feet per second (cfs) respectively (Philip Williams & Associates 1998).

The *lower reach of Pacheco Creek* is defined as the region downstream of the Northwest Pacific Railroad Bridge crossing. In this reach, overtopping due to downstream backwater effects is known to occur for flows smaller than the 10-year event (California Coastal Conservancy and U.S. Army Corps of Engineers 1998, Philip Williams & Associates 1998). When flooding occurs, overflow is directed toward Landfill 26 and back to Pacheco Pond over the Ammo Hill saddle if the water surface elevation exceeds 7.7 feet NGVD 29 (Philip Williams & Associates 1998).

1.5 Arroyo San Jose

Arroyo San Jose drains a watershed of approximately 5.4 square miles. Like Pacheco Creek, Arroyo San Jose has its headwaters on Big Rock Ridge and discharges into Pacheco Pond. The 10-year and 100-year discharges are 1,369 and 2,455 cfs, respectively (Philip Williams & Associates 1998). Arroyo San Jose accounts for approximately 75% of the inflow to Pacheco Pond (Philip Williams & Associates 1998).

Arroyo San Jose is expected to remain within its banks during floods as large as the 100-year event, with the exception of the lower reaches, where high stages in Pacheco Pond can cause overtopping due to backwater effects (California Coastal Conservancy and U.S. Army Corps of Engineers 1998).

1.6 Pacheco Pond

Pacheco Pond, also known as Ignacio Reservoir, was constructed by the Marin County Flood Control and Water Conservation District (MCFCWCD) as a detention basin for flows from Pacheco Creek and Arroyo San Jose. It also provides freshwater wetland and wildlife habitat. The pond is jointly managed by the MCFCWCD and the California Department of Fish and Game (CDFG).

Pacheco Pond covers an area of approximately 120 acres and has an estimated flood storage volume of 866 acre-feet at an elevation of approximately 7 feet NGVD 29 (see attached NHC memorandum dated 14 October 2002). It discharges into Novato Creek via a levied channel controlled by a weir structure with an invert elevation of –0.86 feet NDVD 29 (PWA, October 1998) which has six 4-foot by 4-foot flap gates. Two slide-

gated siphons formerly served to drain overflow from the pond to HAAF; however, these structures are not in operation at present (Philip Williams & Associates 1998).

A sill at the upstream face of the Bel Marin Keys Blvd. culvert controls water surface elevations in Pacheco Pond. Inserting flashboards on the upstream side of the culvert can raise the minimum pond elevation. An operating agreement between the MCFCWCD and CDFG establishes the desired water surface elevation in the pond at 1.5 feet above MSL. The minimum pond water surface elevation is equivalent to the sill elevation of the culvert (approximately –0.8 feet NGVD 29). The actual low-flow water surface elevation in the pond is assumed to be approximately 0 feet NGVD 29 (see attached NHC memorandum dated 14 October 2002).

During high flow events, the water level in Pacheco Pond may exceed the elevation of adjacent levees. The lowest point in the levees (elevation 5.6 feet NGVD 29) is north of the pond, adjacent to the Leveroni property. However, overtopping occurs primarily on the west side of the pond near Ignacio Business Park and near the confluence of the outflow channel with Novato Creek (Philip Williams & Associates 1998).

1.7 Novato Creek

Novato Creek is the principal drainage in the project vicinity, and has an approximate total watershed area of 44 square miles (U.S. Army Corps of Engineers 1987). The Corps has computed 10-year and 100-year discharges near the Highway 101 crossing at 3,420 cfs and 6,230 cfs, respectively (U.S. Army Corps of Engineers 1987), and recognizes an "ultimate flow" of 8,000 cfs at the mouth of Novato Creek. However, the railroad bridges downstream of Highway 101 and adjacent to Highway 37 constrict flow, causing overtopping upstream of the lowest reach of Novato Creek and reducing the actual discharge in the lower reaches of the creek; the 8,000-cfs value in particular is unlikely to pertain to the reaches of Novato Creek adjacent to the BMKV site (CSW/Stuber-Stroeh Engineering Group 1996).

Additional modeling efforts have shown that the tidal influence extends upstream of Highway 101 to the City of Novato during flows greater than the 10-year event (FEMA 1998).

1.8 Bel Marin Keys Development

The Bel Marin Keys development is located adjacent to the northwest boundary of the BMK-V project site. Bel Marin Keys is a waterfront residential community with 2 internal constructed lagoons that offer access to Novato Creek though a system of locks. The Bel Marin Keys community uses Novato Creek for boat access to San Pablo Bay and relies on tidal changes in water level to periodically exchange flow between the Bel Marin Keys lagoons and San Pablo Bay.

Water level is managed at 2 feet NGVD 29 in the north lagoon and 0.5–1 foot NGVD 29 in the south lagoon (CSW/Stuber-Stroeh Engineering 1996). Storm water drainage from Bel Marin Keys South Lagoon discharges into the project site via a weir in the levee on

the eastern edge of the south lagoon. Storm water may also be discharged to Novato Creek via the boat access lock on the east or gated culverts on the west sides of the South Lagoon. Discharge into Novato Creek is limited by stage in the creek; during high-flow periods, runoff is impounded in the lagoons until flow in Novato Creek recedes (CSW/Stuber-Stroeh Engineering 1996).

1.9 Hamilton Army Airfield

The former HAAF property is located south of the BMKV project site. The HAAF site receives flood overflows from Pacheco Creek via a 48-inch flap gate that serve the Landfill 26, Ammo Hill, and POL Hill areas. Under some conditions, HAAF receives overflows from Pacheco Pond via 2 slide-gated siphons, although these siphons are not presently operational (Philip Williams & Associates 1998). Flood overflows also enter the HAAF site from the BKMV parcel, through a levee gap approximately 2,000 feet southeast of the HAAF site's northwest corner under some conditions.

1.10 Existing Flood Protection Benefits Provided by Bel Marin Keys V Site

The BMKV site is under F-1 (primary floodway) and F-2 (secondary floodway) overlay zoning pursuant to the Marin Countywide Plan (County of Marin 1994), and is subject to flood protection covenants that further restrict development to ensure that the site continues to fulfill a flood protection function for adjacent parcels. Under existing conditions, the designated flood protection function of the site is to accommodate overflow from Pacheco Pond, Novato Creek, and the constructed South Lagoon at the Bel Marin Keys development.

Based on modeling of water surface elevations by Northwest Hydraulics (see App. E, section 5) and analysis of existing topography and infrastructure, the following sequence of overflow events is expected to occur in response to a flood of approximately 10-year magnitude. The 100-year flood event is expected to generate a sequence of overflow events similar to that modeled for the 10-year flood.

Backwater effects propagating upstream from the confluence of the Pacheco Pond outflow channel with Novato Creek lead to overtopping and overland inundation in Ignacio Business Park. Overland runoff drains southeast toward Ammo Hill; some may return immediately overland to Pacheco Pond, with the remainder draining southward toward the Landfill 26 area.

In floods approximating the 10-year event, water surface elevation in Novato Creek adjacent to the Bel Marin Keys South Lagoon outlet lock is expected to be approximately 5.8 feet NGVD 29. The low point in the Novato Creek levee has an elevation of approximately 5.6 feet (San Francisco International Airport, 2001). The 10-year event and larger floods are thus likely to generate overflow from Novato Creek onto the BMKV site. However, because of the height of the levee separating Pacheco Pond from the BMKV site, the pond is unlikely to overtop the levee in events up to and including approximately the 100-year flood

Under existing conditions, storm water runoff that enters the BMKV site is ponded. It is reduced by evaporation or by pumping and discharge into San Pablo Bay. Net infiltration into the groundwater is not thought to occur on the site.

2. Sediment Budget and Site Evolution

The sediment budget in the San Francisco Bay–San Pablo Bay system is a key factor in restoration design, because the design development process relies on natural delivery of sediment to transform the framework created by restoration construction into a functioning mature marshland over time. The fine sediment fraction (suspended load and fine bed load) is particularly important because it provides the primary sedimentary building blocks for naturally evolving tidal marsh regimes. The following sections provide additional information on sediment loading in the San Pablo Bay system, with a focus on the fine (suspended load) fraction.

2.1 Suspended Sediment Loading in the San Francisco Bay Estuary

A balance of factors controls suspended sediment concentration. Important influences on suspended sediment loading include wind speed and direction (i.e., the magnitude of wind-driven waves and strength of wave currents), freshwater influx, and tidal currents (Northwest Hydraulic Consultants 2001). Freshwater influx shows a strong seasonal variation, with a peak during the winter (November–April) rainy season; land-derived sediment loading shows a corresponding peak in the winter. Tidal currents vary on a semi-monthly basis from neap tides to spring tides, with the greatest sediment mobility at spring tides.

Throughout the year, suspended sediment concentrations are generally highest in the North Bay region and at the southern end of the Bay. USGS data show average concentrations of ~80–150 milligram/liter (mg/l) in San Pablo Bay and 100–200 mg/l in the South Bay for water years 1997 and 1998. Sediment concentrations are typically lower in the central portion of the Bay (Northwest Hydraulic Consultants 2001).

Relatively small creeks feed many of the North Bay's sloughs. Sediment concentrations in these sloughs ranges 41 to 386 mg/l and typically decreases with increasing distance from San Pablo Bay (Warner and Schoellhammer 1999, Buchanan and Ruhl 2000), because the Bay is their primary source of sediment. By contrast, the larger Petaluma River system carries a substantial suspended sediment load because of its larger watershed. Sedimentation rates at locations on the margin of San Pablo Bay near the river mouth (e.g., Bel Marin Keys, Port Sonoma Marina, and Petaluma Marsh) are as much as 0.5–1.3 feet per year (U.S. Army Corps of Engineers 1998).

2.2 Gold Rush Era Effects on SF Bay Sediment Budget

The hydraulic mining that occurred in the foothills of the Sierra Nevada from 1850 to 1884 resulted in the discharge of large amounts of sediment into streams and rivers draining westward toward the San Francisco Bay estuary. The sediment load contributed by hydraulic mining was substantially in excess of the system's natural load, and large

amounts of sediment were deposited in the northernmost embayments in the estuary, resulting in infilling and accretion of a significant portion of Suisun and San Pablo Bays.

A key question for restoration design now centers on expected annual sediment loading and deposition rates around the Bay. While a number of studies suggest that excess sediment related to hydraulic mining is no longer being delivered to the Bay in large amounts, diversion and detention of Central Valley waters since about 1950 has also significantly altered freshwater discharge into the Bay system, and there is disagreement among restoration proponents regarding both the anticipated sediment budget and realistic water discharge values.

2.3 Sediment Budget Assumptions for Restoration Design

In order to provide a basis for restoration design at Bel Marin Keys, Northwest Hydraulics Consultants (2001) modeled yearly sediment loading in San Pablo Bay based on average monthly water discharge values and observed concentrations of suspended sediment for water years 1997 and 1998. Water discharge data were obtained from U.S. Geological Survey (USGS) stream gages located immediately upstream of the Bay estuary (the Freeport gage on the Sacramento River and the Vernalis gage on the San Joaquin River). Data on suspended sediment concentration (SSC) were taken from the USGS near-bottom sensor at the Benecia Bridge in Suisun Bay (USGS 1999, USGS 2000).

3. Navigation

No negative impacts to Federal navigation channels are expected from the combined HWRP and BMK-V project.

There may be potential effects to the small navigable channel in lower reaches of Novato Creek due to potential alternatives of the BMK-V expansion. In particular, Alternatives 1 and 2 currently propose tidal breaches to Novato Creek.
These tidal breached will likely have a small positive effect on the channel width and depth in Novato Creek below the breaches. It is recommended that during future project studies the potential navigation changes to Novato Creek be evaluated and quantified. These studies and findings should be coordinated with the Bel Marin Keys Community Service District and residents, since they are the primary group that utilizes this channel for navigation.

4. Water Control Structures

The primary water control structures associated with the Revised Alternative 2 of the BMK-V expansion of the HWRP are:

- Two Overflow weirs from the BMK South Lagoon into the constructed seasonal wetland swale;
- One Outlet culvert with flap gate to Novato Creek out of the seasonal wetland swale;

- Weir and outlet culvert with flap gate from Pacheco Pond into the seasonal wetland and a weir and outlet culvert with flap gate from the seasonal wetland into the tidal wetland; and
- Temporary water control pumps or weirs associated with the control of dredged material process water and site storm water during construction.

During the Pre-construction, Engineering and Design (PED) phase the design requirements for the necessary water control structures will be finalized. However, none of these structures are expected to be atypical or extraordinary. Therefore, the design and construction of these features is expected to relatively routine.

The overflow weirs from the BMK South Lagoon into the seasonal wetland swale will require hydrological analysis to determine the design flow rate and appropriate structural design for integration into the improved South Lagoon Levee. These requirements will be incorporated into the final construction plans and specifications.

The outlet culvert with flap gate to Novato Creek out of the seasonal wetland and the outlet culvert with flap gate from Pacheco Pond into the tidal wetland will also require hydrological analysis to determine the design flow rates and structural design for integration into the project berms and levees.

Based on the final wetland design template and the dredged material placement plan the temporary water control pumps or weirs associated with the control of dredged material process water and site storm water during construction will require basic design and development of a performance based specification to incorporate into the dredged material placement contract.

5.0 Hydraulic Modeling and Flood Zoning

The following pages contain Memoranda from North West Hydraulics Consultants summarizing their hydraulic modeling efforts for the project, including currently available results and plans for further study. Descriptions of local Flood Zoning Ordinances covering the BMK-V parcel are also provided in the Memoranda.

Memorandum

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Date:	14 October 2002	**Project:**	50283
To:	Rich Walter		
Company/Agency:	Jones & Stokes		
From:	Brad Hall		
Subject:	Hydrologic and Hydraulic Modeling Assessment of Existing and Project Alternatives at Bel Marin Keys V		

This memorandum is issued to clarify citations presented in the 18 April 2002 memorandum. The analyses, results, and conclusions of this memorandum were not modified from the 18 April 2002 memorandum.

Overview

This document presents Northwest Hydraulic Consultants (**nhc**) investigation of the hydraulic impact of the proposed Bel Marin Keys tidal marsh restoration project. This study quantitatively assesses the relative change of the proposed project on Pacheco Pond stages and Novato Creek stages from the Pacheco Pond outlet to the creek mouth.

The proposed tidal marsh restoration at Bel Marin Keys will affect the hydrology of several elements within the lower Novato Creek basin. Proposed modifications to Pacheco Pond and the proposed diversion of flow away from Novato Creek considered in the design alternatives will present the most substantial effects. The proposed modifications to Pacheco Pond consist of either expanding the existing pond, or creating a seasonal marsh adjacent to the pond. In addition, the diversion of water currently flowing into Novato Creek from Pacheco Pond, to the proposed tidal marsh will greatly affect existing conditions on the Bel Marin Keys tidal wetlands restoration site. These flows will provide fresh water for the proposed freshwater marsh portion of the project.

To assess the impacts of the proposed tidal wetland restoration on the hydrology of the existing site a review of hydrologic studies of the Novato Creek and Pacheco Pond watersheds was completed. Existing and proposed site conditions that affect the drainage and flooding characteristics were identified. Representative flood hydrographs and tidal stage characteristics were determined and used for computing flood stage and discharge conditions in the study area. To quantify the changes in flood stage and discharge magnitude resulting from coincident terrestrial and tidal flood conditions, a one-dimensional, unsteady flow model of the Novato Creek and Pacheco Pond system was developed. Described below are some features of this modeling effort, including a description of the basin, the proposed alternatives, the model itself, and the model results.

Basin Description

The components of the Pacheco Pond watershed consist of two small streams, Pacheco Creek and Arroyo San Jose, which drain into a constructed detention reservoir, Pacheco Pond. Pacheco Pond currently discharges into Novato Creek and finally, San Pablo Bay (Figure 1). Historically, Pacheco Creek and Arroyo San Jose discharged into the tidal marsh to the south of the Bel Marin Keys development. The specific features of the watershed are described below.

- *Pacheco Creek*

Pacheco creek drains a 1.9 square mile watershed. From the headwaters 3 miles to the west, the stream crosses several roads, including Highway 101, through a series of culverts. Flooding is known to occur in the lower reaches of Pacheco Creek, prior to entering Pacheco Pond, for flood events with magnitudes less than the 10-year event (1).

However, because this study focused on the area downstream of Pacheco Pond, the flooding of the creek upstream of the pond was not analyzed in the modeling study. Flows of Pacheco Creek into the pond were modeled as an inflow hydrograph entering the pond, as will be described below. Additional survey of channel cross sections and physical characteristics of the local storm drainage system would be required to quantify flooding conditions upstream of Pacheco Pond and within the Ignacio Business Park.

- *Arroyo San Jose*

The Arroyo San Jose watershed drains an area of approximately 5.4 square miles. Arroyo San Jose accounts for approximately three-quarters of the inflow to Pacheco Pond (2). Previous hydrologic studies of the basin indicate that the Arroyo San Jose remains within its banks for flood events up to the 100-year flood. However, accompanied with high tides in Novato Creek and the associated constriction of flow release from Pacheco Pond, the 100-year event can cause minor flooding of residential and business areas near the confluence with Pacheco Pond (1).

- *Pacheco Pond*

Pacheco Pond covers an area of approximately 120 acres. The estimated flood storage volume between elevations 0.0 and 7.0-ft, NGVD 29, is approximately 866 acre-ft. The storage volume of the reservoir was estimated from existing topographic surveys, aerial photos, and previous engineering studies (3, 4). A stage-volume relation for Pacheco Pond was determined and utilized to compute the pond storage and resultant water surface elevation during storm events.

Pacheco Pond discharges into Novato Creek via a leveed channel controlled by six 4-ft by 4-ft flap gated culverts. The invert elevation of the culvert structure was independently surveyed by **nhc** and the Marin County Flood Control District to have an invert elevation of –0.86-ft, NGVD 29. It appears that the invert of the culvert was not accurately surveyed in earlier studies of Pacheco Pond hydrology, and was reported to have an invert elevation of –1.8-ft, NGVD 29 (2). The effect of the flap gate was modeled by only allowing flow in the positive direction (toward Novato Creek) through

the box culvert. Minor leakage and backflow through the flap gates was not modeled in this analysis.

During high flow events the water level in Pacheco Pond can exceed adjacent levee elevations. The lowest point exists north of the pond, adjacent to the Leveroni property, where the measured low point of the levee is 5.6-ft, NGVD 29 (2). These low points were considered in the model by including lateral weirs to direct flow to adjacent storage areas when stages in the pond exceeded 5.6-ft. Top of levee surveys also indicate that a significant extent of this levee is at an elevation of approximately 6.7-ft, NGVD 29. Additional lateral overflow weirs were specified at this higher top of levee elevation in the hydraulic model.

- *Novato Creek*

Novato creek is the main drainage course in the region with an approximate total watershed area of 44 square miles (5). However, breakout flows due to flow constrictions at the railroad bridges downstream of Highway 101, and adjacent to Highway 37, reduce the overall peak flood discharge (6). An infinite variation in the timing of peak discharges between Novato Creek and Pacheco Pond hydrographs is possible; however, the Novato Creek peak would be expected to lag the Pacheco Pond peak due to the larger watershed area of Novato Creek. Water surface conditions within Pacheco Pond and within Novato Creek were evaluated for lag times between peak flows of zero, six, and 12 hours.

Cross sections of Novato Creek were developed by **nhc** from existing LiDAR (3) and bathymetric surveys (7). The cross sections depict the subtidal channel of the creek, adjacent tidal marsh surface, and existing levee structures that currently constrain the Novato Creek floodplain. Top of levee surveys completed in 1996, indicate that the levee crest between Novato Creek and the Bel Marin Keys V site dips to an elevation of approximately 5.6-ft, NGVD 29, at a point approximately 1000 feet downstream from the Bel Marin Keys South Lagoon navigation lock. Overtopping of this levee was observed by Bel Marin Keys residents in the February 1998 flood event. The location of this overtopping was incorporated in the hydraulic model by specifying an overtopping weir with a crest elevation of 5.6-ft, in the model geometry at this location.

- *San Pablo BayTides*

Tides in San Pablo Bay follow a mixed semidiurnal cycle, with two high and two low tides, of differing heights, occurring in a single day. Due to geographic and hydrodynamic complexities, mean tide levels vary throughout the San Francisco/San Pablo Bay system. Tide cycles in San Pablo Bay are seen to lag those at the Golden Gate by as much as 75 minutes (2). Peak tide water surface elevations in the vicinity of Novato Creek are reported as 6.0-ft, NGVD 29 for the 10-year tide and 6.5-ft, NGVD 29 for the 100-year tide (8). FEMA maps tidal water surface elevations to the nearest whole-foot (9). Therefore, the Base Flood Elevation resulting from tidal flooding in the City of Novato is 7 feet (10).

Storm events lead to higher tidal stages than those predicted by gravitational forces for a variety of reasons. First, low barometric pressures associated with significant storm frontal passage leads to a regional rise in tidal stage as the oceans surface level increases in response to the reduction in overlying atmospheric pressure. Second, wind

stresses may lead to a storm surge setup, further increasing peak tidal stage. Third, increases in large scale regional runoff from the Sacramento and San Joaquin watersheds, as well as contributions from San Francisco Bay watersheds, limit the low tidal excursion of normal tidal cycles. San Pablo Bay, in essence, is filled with regional runoff (11).

The tide measurements taken at the mouth of the Petaluma River were utilized to develop time series of tidal stage hydrographs at the mouth of Novato Creek. These data, completed as part of the San Francisco Airport runway expansion dredge material disposal studies, consist of tidal stage measurements recorded at 10-minute increments for the duration of approximately one month (14 June - 17 July 2000) (3). Earlier studies of Novato Creek indicate negligible differences between Novato Creek and Petaluma River tidal stage characteristics (2). To conservatively estimate tidal conditions during flood events, these tide stage data were modified in two ways to reflect extreme tidal conditions that occur during significant flooding events. The first modification was to increase the observed peak tidal stage by one foot to reflect extreme high tides due to low atmospheric pressure and wind setup in the region. This is equivalent to coincident tidal stage boundary conditions frequently used by the Corps of Engineers and the FEMA for flood control design or flood hazard mapping studies on tidally influenced streams and rivers (12). The resulting peak tide is 5.75 feet, 0.25 feet lower than the 10-year peak tide of 6 feet. The second modification was to truncate the low tide elevation at the mean tide level to represent limits on low tide excursion due to extreme regional, basin-wide runoff conditions.

Alternative Descriptions

The descriptions of Alternatives 1, 2, and 3, given below consist of that information that is relevant to the hydrologic modeling effort. That is, only the elements that affect the hydrology and hydraulics of the site are considered. For all project alternatives, Pacheco Pond flows will be routed to Novato Creek during storm events. In the following analyses, Pacheco Pond flows were routed to the restored tidal marsh for all project alternatives. The key hydrologic characteristics of the three alternatives are described below:

Alternative 1

- Pacheco Pond expanded to a capacity of approximately 1241 acre-ft (above 0-ft, NGVD 29)
- flow diverted to proposed tidal marsh from Pacheco Pond through a flap gated culvert structure identical to the existing one at Novato Creek

Alternative 2

- seasonal wetland constructed adjacent to existing Pacheco Pond with a storage volume of approximately 1155 acre-ft (above 0-ft, NGVD 29)
- existing Pacheco Pond and seasonal wetland connected with a 100-ft wide weir, with a crest elevation of 2-ft, NVGD 29
- flow from the seasonal wetland is released to the proposed tidal marsh through a flap gated culvert structure identical to the existing one at Novato Creek

Alternative 3

- for the purposes of this analysis, identical to Alternative 1 .

UNET Model Description

To evaluate the hydraulics of the existing study basin, as well as the proposed project conditions, the hydraulic modeling program UNET was employed. UNET was developed by the U.S. Army Corps of Engineers, and provides a modeling framework for computing solutions to one-dimensional, unsteady flow problems in complex networks. The choice of using such a model was deemed necessary here due to the dynamic conditions caused by both the fluctuating tide levels in San Pablo Bay, and the rapid changes in water surface elevation expected within Pacheco Pond.

The UNET model requires hydraulic boundary conditions for both the up stream and downstream ends of the study site. For this study, the downstream boundary conditions consisted of the modified, tidal time series measured at the mouth of the Petaluma River as described above. The tidal time series data are shown in Figure 2.

The upstream boundary conditions consisted of inflow storm hydrographs. The storm hydrographs for Pacheco Creek at Pacheco Pond, Arroyo San Jose at Pacheco Pond, and Novato Creek near Highway 37 were obtained from previous studies (2, 5, 6). The hydrologic conditions considered in the analysis consisted of two scenarios. These scenarios, referred to here as A and B, are meant to loosely represent the 10-year and 100-year storm events, respectively. However, a detailed assessment of present and future watershed conditions, coincident storm peak flow analysis, and hydrologic routing characteristics that would more accurately define the expected characteristics of storm hydrographs was beyond the scope of this study. The flow hydrographs for Arroyo San Jose, Pacheco Creek, and Novato Creek for both scenarios A and B are shown in Figures 3, 4, and 5.

Theoretically, there are infinite combinations of phasing between the peak tide and the peak discharge hydrographs. To simplify the analysis, Pacheco Creek and Arroyo San Jose hydrographs were phased to be coincident with the higher high water tidal stage for all model runs. However, the phasing of the Novato Creek hydrograph was varied to investigate the effect of lag times on system. Due to the larger watershed dimensions, the peak discharge from Novato Creek would be expected to lag the Pacheco Pond peak discharges. Novato Creek hydrographs specified at three different lag times relative to the peak hydrograph from the Pacheco Pond watershed: 0-hour lag time (i.e. coincident with the higher high water tide stage and other hydrographs), 6-hour lag time (i.e. 6 hours behind other hydrographs), and 12-hour lag time. The adjustment of phasing was only relevant to the model runs that evaluated the existing conditions, as Pacheco Pond flows are routed away from Novato Creek for all project condition scenarios.

The general modeling strategy was to isolate elements within the drainage system in order to assess their relative effect on peak flows and water surface elevations. A key caveat of this analysis is that the primary consideration should be in comparing *relative* differences between computed peak discharges and water surface elevations. Detailed and consistent surveys of the physical characteristics of Pacheco Pond and Novato Creek are necessary to identify accurate, water surface elevations. These surveys were beyond the scope of this conceptual planning effort. However, *relative* differences in peak water surface elevations and flowrates between the alternative conditions assessed in this analysis are fairly insensitive (less than 0.25 feet) to the small changes in absolute geometric conditions (e.g. plus or minus 1-foot of vertical difference in invert

elevations). Thus, the relative changes between existing and project alternative conditions can be used to assess project performance and impacts.

Four cases were considered. The first consisted of modeling the existing Pacheco Pond-Novato Creek system. The second case considered only Novato Creek, without contributing flows from Pacheco Pond, and the third and fourth cases considered only the isolated Pacheco Pond. These third and fourth cases were used to evaluate the effects and differences between Alternatives 1 & 3, and 2, on pond hydraulics. The primary assumption in the third and fourth cases is that the entire flow into Pacheco Pond will be rerouted to the proposed tidal marsh. Table 1 outlines the modeling conditions for each case.

Table 1. UNET Model Conditions

Case	Model Conditions
Existing Novato Creek and Pacheco Pond Network - Evaluates the interaction between Pacheco Pond and Novato Creek for existing conditions	**Boundary Conditions** • Arroyo San Jose: Scenario A and B Hydrographs • Pacheco Creek: Scenario A and B Hydrographs • Novato Creek: Scenario A and B Hydrographs; 0, 6, 12 hour lag • San Pablo Bay: Truncated/amplified tide series **Model Elements** • Six 4-ft tall by 4-ft wide, unidirectional box culvert controls flow to Novato Ck • 100-ft wide lateral weir at 5.6-ft, NGVD 29 for pond overflow to Leveroni Property • 1000-ft wide lateral weir at 6.7-ft, NGVD 29 for pond overflow • 300-ft wide lateral weir at 5.6-ft, NGVD 29 for Novato Ck overflow to BMKV wetlands restoration site downstream of BMK residential development.
Project Conditions on Novato Creek- Evaluates only Novato Creek while considering influence of added restored tidal prism downstream of BMK residential development. The connection with Pacheco Pond is removed from the model.	**Boundary Conditions** • Novato Creek: Scenario A and B Hydrographs; 12 hour lag • San Pablo Bay: Truncated/amplified tide series **Model Elements** • right bank levee removed downstream of BMK residential development • right bank floodplain expanded laterally by 1000-ft downstream of BMK residential development to reflect opportunity for overflow into restored tidal marsh • 450-acre tidal marsh modeled as storage area with hydraulic connection through new breach channel to lower Novato Creek.
Pacheco Pond Configuration for Alternative 1 & 3 - Evaluates an expanded Pacheco Pond with a flap gate outlet to the tidal marsh	**Boundary Conditions** • Arroyo San Jose: Scenario A and B Hydrographs • Pacheco Creek: Scenario A and B Hydrographs • San Pablo Bay: Truncated/amplified tide series **Model Elements** • Pacheco Pond expanded • Six 4-ft tall by 4-ft wide, unidirectional box culvert controls flow to tidal marsh
Pacheco Pond Configuration for Alternative 2 - Evaluates Pacheco Pond with an adjacent seasonal marsh storage area, flow controlled by weir and flap gate structure	**Boundary Conditions** • Arroyo San Jose: Scenario A and B Hydrographs • Pacheco Creek: Scenario A and B Hydrographs • San Pablo Bay: Truncated/amplified tide series **Model Elements** • Additional 650-acre storage area attached to Pacheco Pond to simulate constructed seasonal wetland • 100-ft wide inline weir to control flow from pond to seasonal marsh • Six 4-ft tall by 4-ft wide, unidirectional box culvert controls flow to tidal marsh

Model Results

The UNET model results of primary interest are the effects of the proposed tidal restoration on the stage within Pacheco Pond and Novato Creek. With respect to the former, comparison between the stage hydrographs within the existing pond (Figs. 6 and 7) and those of Alternatives 1 & 3, and 2 (Figs. 8 and 9), show that the proposed changes will substantially reduce peak water surface elevations within Pacheco Pond (Table 2). This reduction in Pacheco Pond elevations will have a positive benefit on Ignacio Business Park drainage conditions that are presently aggravated by high stages within Pacheco Pond. The magnitude and extent of this improvement to local storm drainage conditions, however, was not quantified in this analysis.

Table 2. Peak Water Surface Elevations in Pacheco Pond (ft, NGVD 29)

Case	Scenario A	Scenario B
Existing	6.4	7.6
Alternative 1 & 3	4.5	7.2
Alternative 2	4.6	6.3

Also of interest are the effects of the proposed project on stages within Novato Creek. Under the project alternatives being considered for the Bel Marin Keys tidal wetland restoration, all flow from Pacheco Pond will be diverted away from Novato Creek and routed through new drainage structures into the proposed tidal marsh. To examine the effect of this diversion, stage hydrographs at select locations along Novato Creek are presented in Figures 10 and 11, for scenarios A and B, respectively. The locations chosen include the upstream limit of the model at Highway 37 bridge (CS 10), at the existing confluence of Pacheco Pond with Novato Creek (CS 8), and just downstream of the lower Bel Marin Keys navigational lock (CS 4).

The stage hydrographs shown in Figures 10 and 11, suggest that peak water surface elevations within Novato Creek are controlled primarily by tidal fluctuations. That is, the effects of diverting Pacheco Pond flow, in addition to the added tidal prism created by the constructed tidal marsh, do not substantially change the peak water surface elevations between existing and project conditions. The changes that do occur are a negligible drop (less than 0.1 foot) in peak stage when Pacheco Pond flow is diverted.

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11. Charles D. Anderson, Katherine M. Oven, Christy Chung, 2000. "Surf's Up – or Tide Cycles During Storm Events." Spring 2000 Floodplain Managers Association Conference, San Diego, CA.

12. U.S. Army Corps of Engineers, Sacramento District. 1993. "Coyote and Berryessa Creeks, California Final General Design Memorandum".

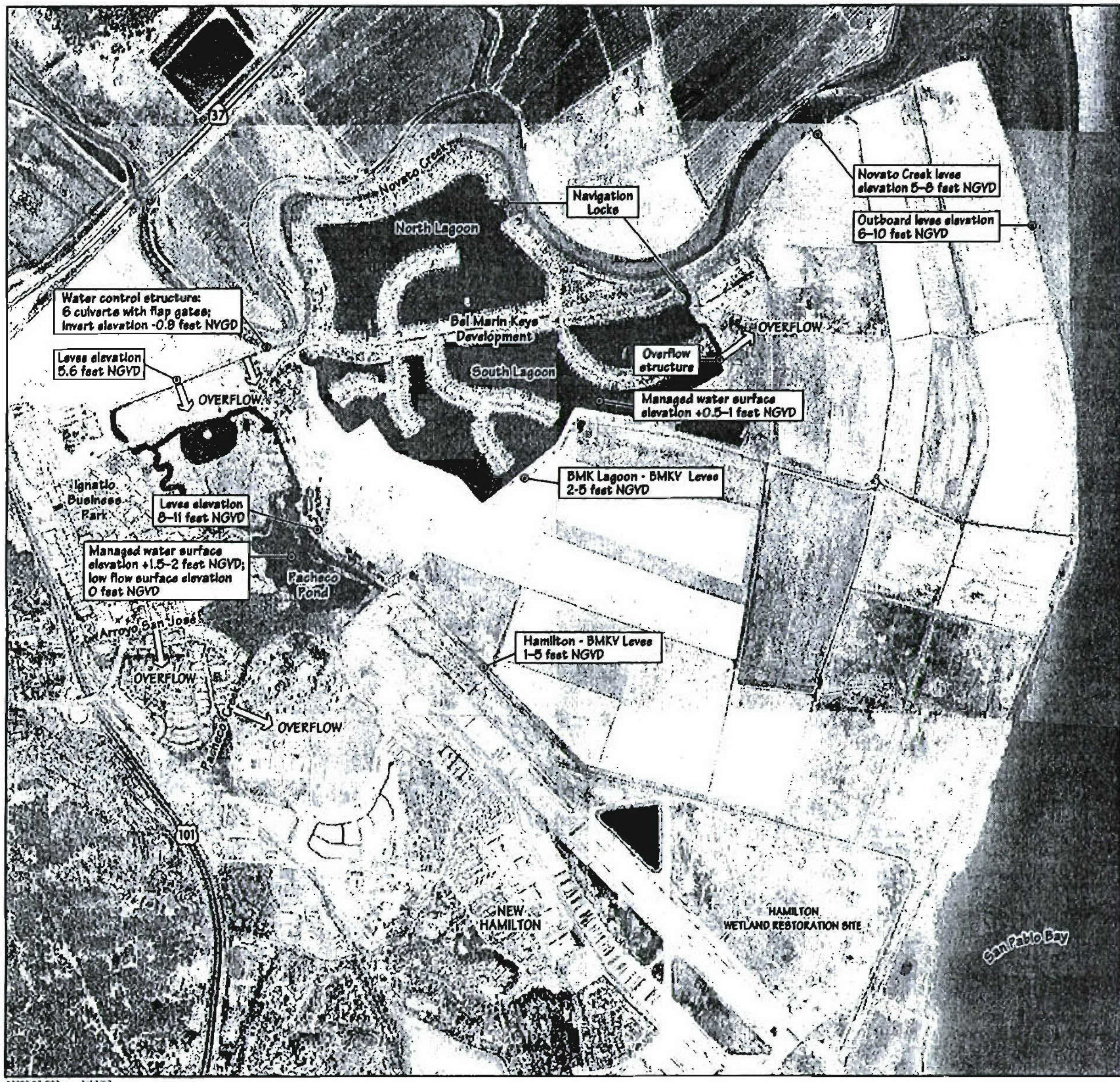


Figure 1
Hydrologic Setting at the Project Site

Jones & Stokes nhc

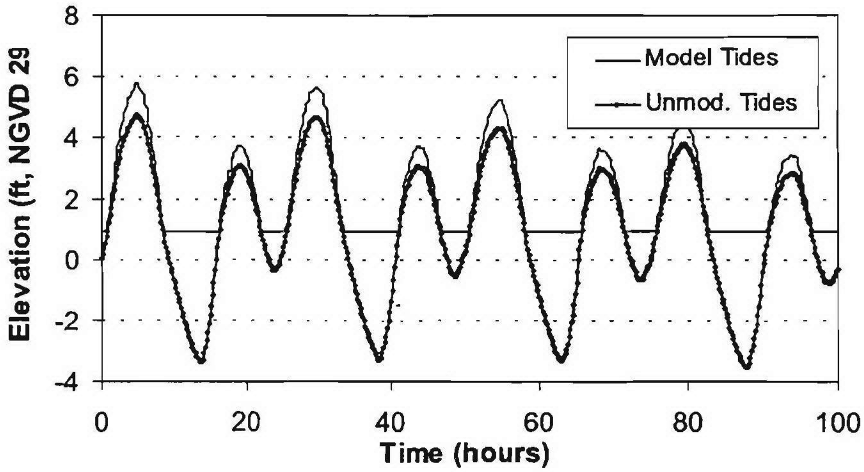


Figure 2. Unmodified tide series, and tide series used in UNET model

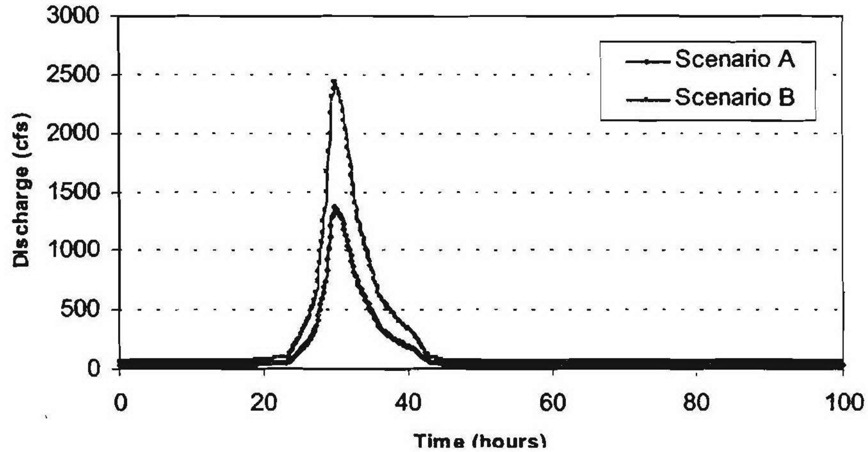


Figure 3. Arroyo San Jose Input Hydrographs

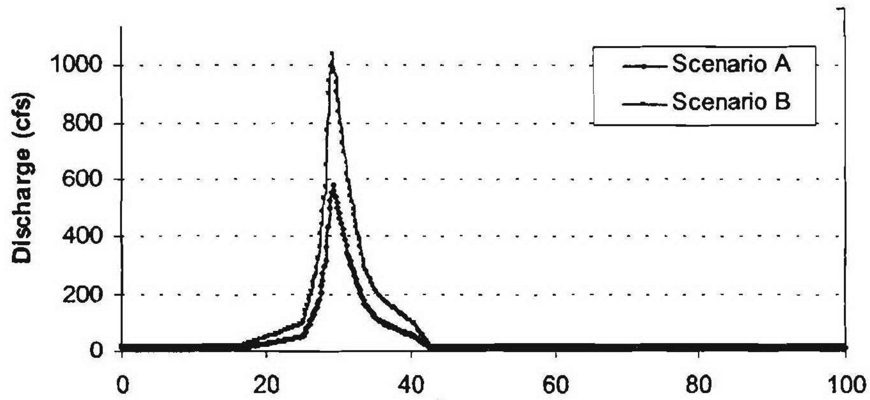


Figure 4. Pacheco Creek Input Hydrographs

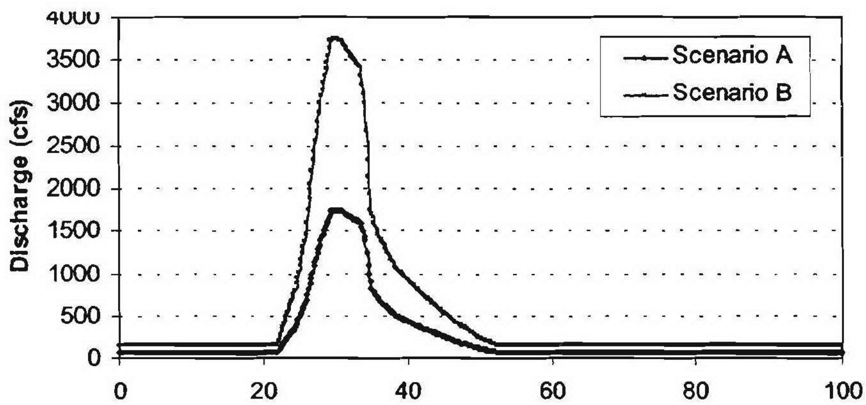


Figure 5. Novato Creek Input Hydrographs (0-hour lag)

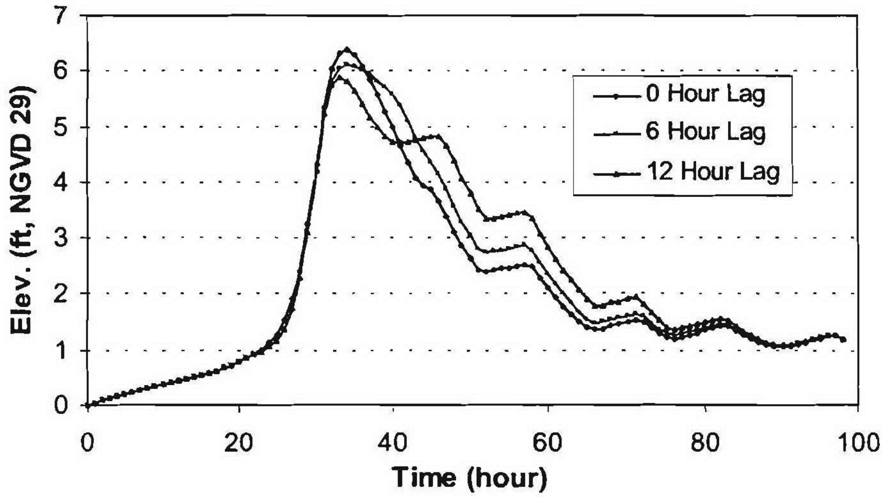


Figure 6. Pacheco Pond water surface elevations, existing conditions, Scenario A

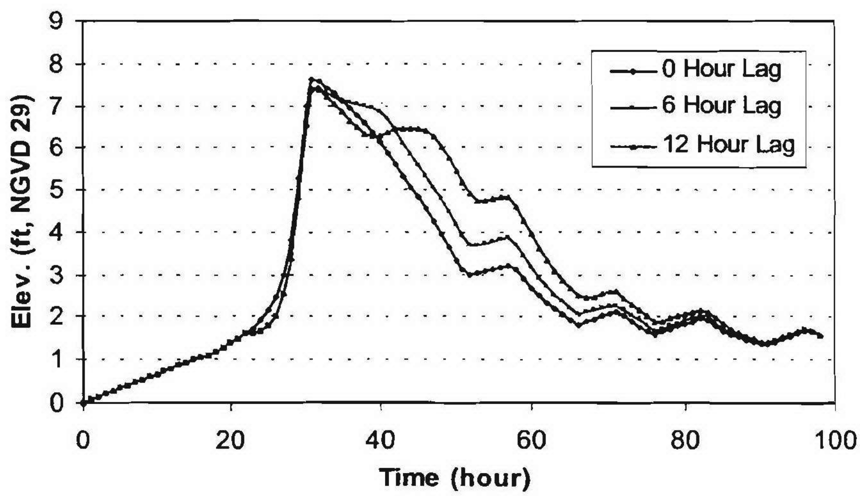


Figure 7. Pacheco Pond water surface elevations, existing conditions, Scenario B

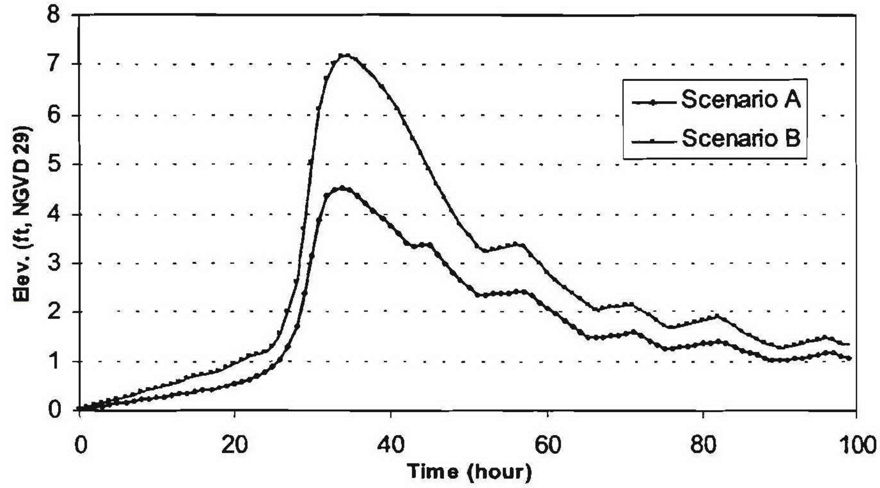


Figure 8. Pacheco Pond water surface elevations, Alternatives 1 & 3

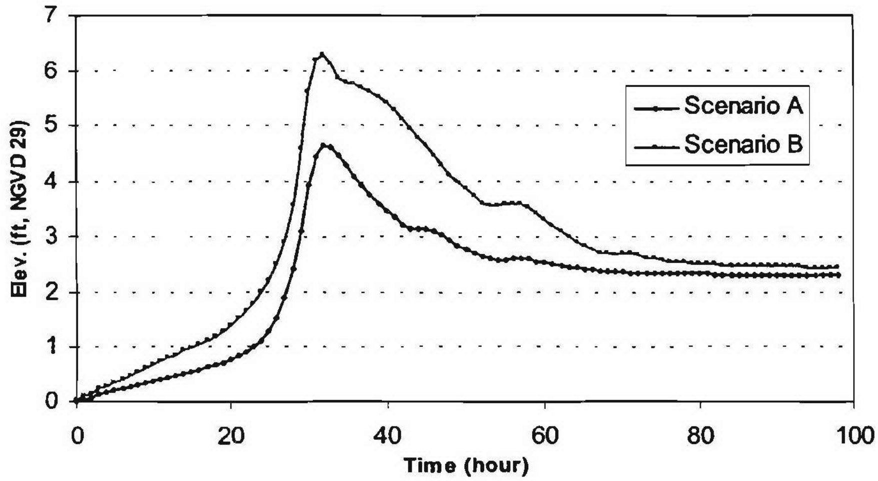


Figure 9. Pacheco Pond water surface elevations, Alternative 2

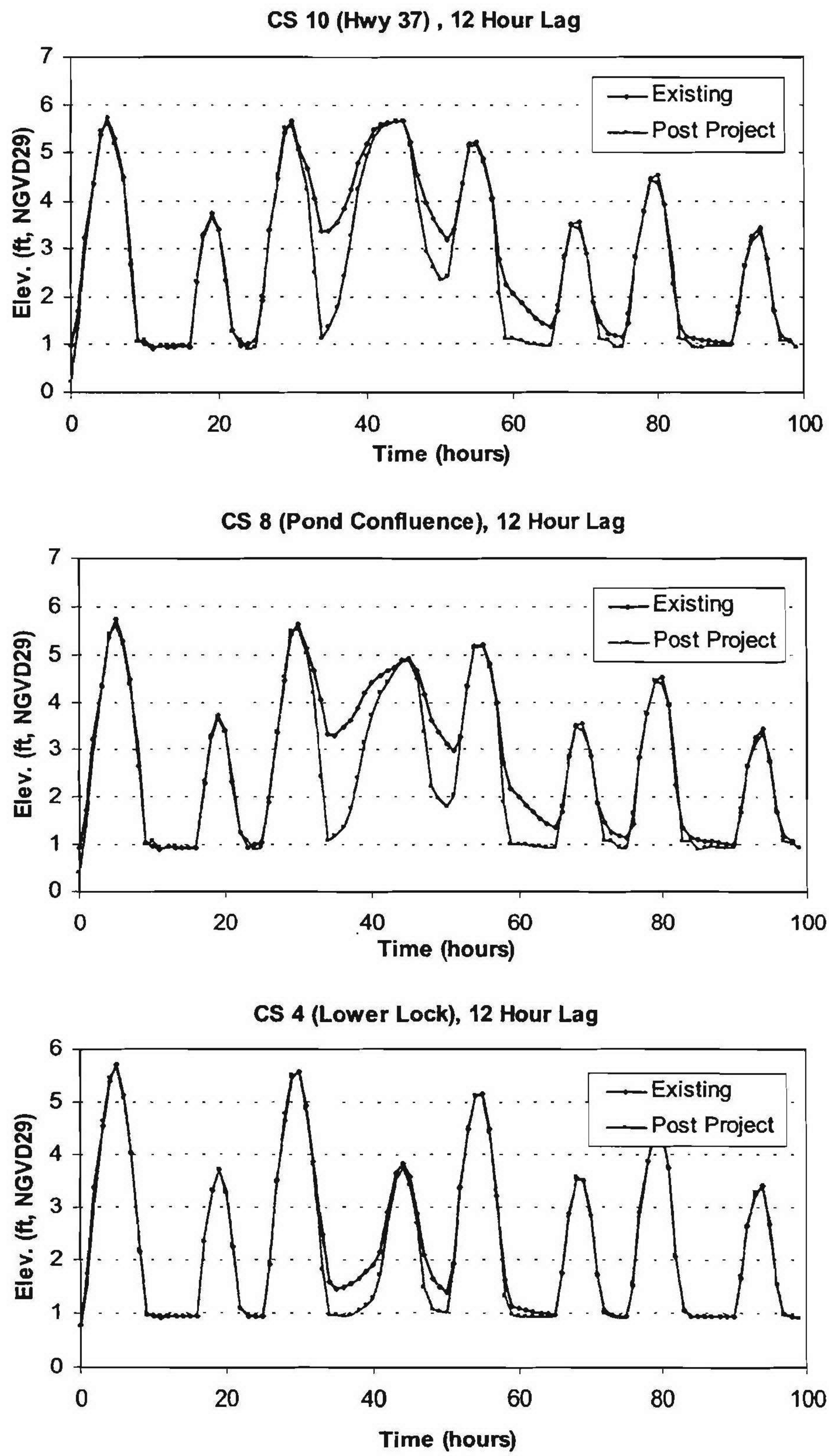
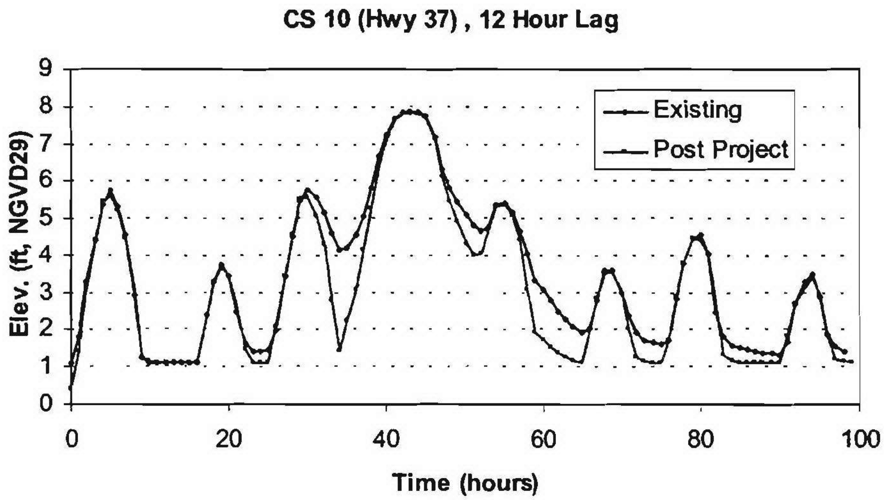
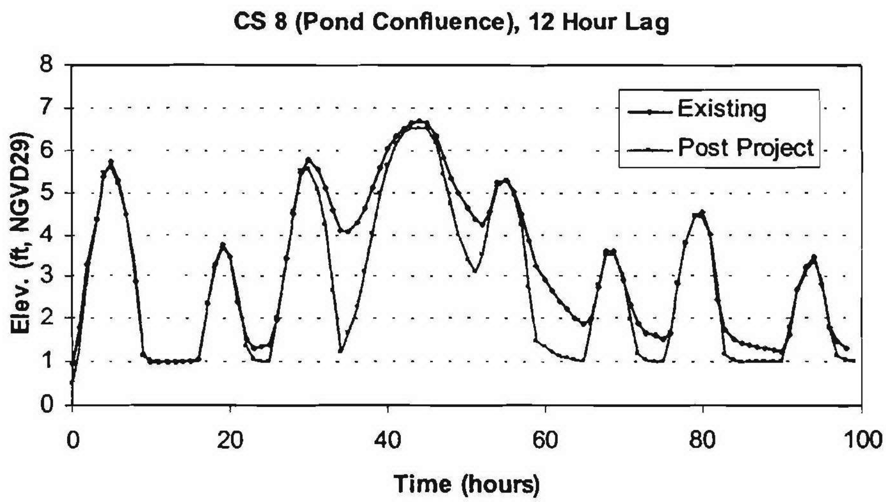


Figure 10. Stage hydrographs at select locations along Novato Creek, Scenario A





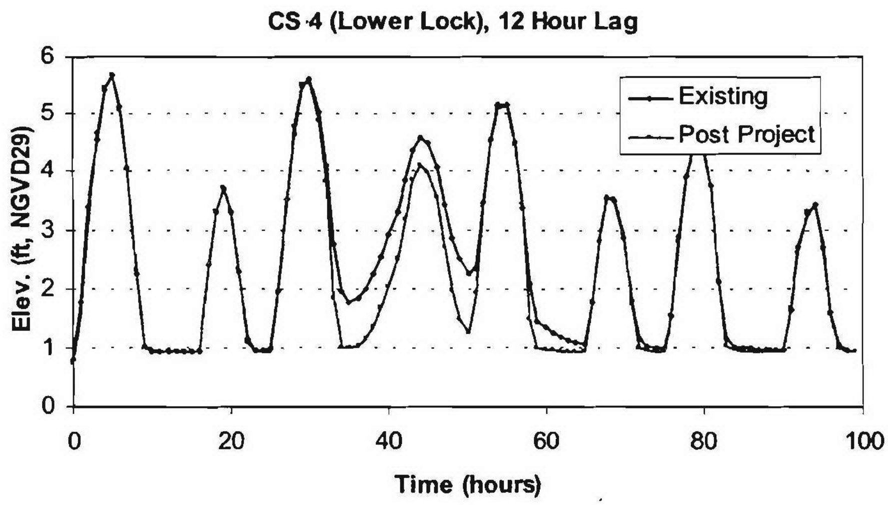


Figure 11. Stage hydrographs at select locations along Novato Creek, Scenario B

Bel Marin Keys Unit V Expansion of the Hamilton Wetland Restoration Project

Hydraulic Routing Analysis

Purpose

This document presents a hydraulic impact investigation performed by Northwest Hydraulic Consultants (Bel) of the proposed Bel Marin Keys tidal marsh restoration project on Pacheco Pond and Novato Creek. The purpose of the study was to quantify the relative hydraulic effects of the proposed project on Pacheco Pond and on Novato Creek from the Pacheco Pond outlet to San Pablo Bay.

This document describes supplementary hydrologic and hydraulic analyses initially presented in the technical memorandum entitled "Hydrologic and Hydraulic Modeling Assessment of Existing and Project Alternatives at Bel Marin Keys," dated April 18, 2002 (Bel , 2002a). Supplementary information presented in the following sections of this report includes a refinement of the geometric conditions for Alternative 2, as well as an assessment of additional scenarios for evaluating the effects of Pacheco Pond on existing and project alternative conditions on Novato Creek flood dynamics. Computed time histories of channel velocity, flow rate, and water surface stage for several hydrologic scenarios are also presented in this report.

Background

Over the last two centuries, hydrologic conditions in the Novato Creek watershed below Highway 37 have varied dramatically due to changes in land use practices and engineered modifications to the land surface. These modifications include the construction of flood protection levees, the development of Pacheco Pond as a flood detention system, and the rerouting of drainage channels and installation of flap gates on Simmons Slough and Pacheco Pond. This has decreased the tidal prism of lower Novato Creek significantly, and has resulted in accretion of the channel. The reduction in channel size due to accretion has decreased the flood capacity of the system and has proved undesirable for navigation. The creek is constantly evolving toward a smaller width and depth consistent with the reduced tidal prism. Actions to counter the effects of channel accretion include the periodic surveying and raising of levees along the north side of Novato Creek from Highway 37 to the mouth and dredging of Novato Creek downstream of its confluence with Pacheco Pond.

Hydraulic Setting

Novato Creek is the principal drainage in the vicinity of the project site and has an approximate total watershed area of 44 square miles. Two smaller drainages, Arroyo San Jose (drainage area of 5.4 square miles) and Pacheco Creek (drainage area of 1.9 square miles) discharge into Pacheco Pond. The pond ultimately drains into Novato Creek by means of six 4-foot by 4-foot flap gates. The flap gates open when the stage in Pacheco Pond exceeds the stage in Novato Creek and the invert of the flap-gate culvert, which is approximately -0.86 feet NGVD 29. In addition, Simmons Slough drains lowlands to the north of Novato Creek and discharges into Novato Creek through a flap gate culvert downstream of the Pacheco Pond culvert.

The Bel Marin Keys Community Service District (CSD) operates two locks that provide recreational vessel access to the North and South Lagoons of the community. The North Lock facility includes three tainter gates used for lagoon flushing purposes. Managed releases from the lagoons are conducted by the CSD to promote channel scour in Novato Creek to improve navigability of the tidally influenced portion of Novato Creek. A location map showing the project site and adjacent areas is provided in Figure 1.

Downstream of Highway 101, the geometry of Novato Creek is characteristic of tidally influenced channels throughout San Francisco Bay, and is composed of a consolidated bay mud main channel with tidal salt marsh benches. The slope of the lower channel is relatively mild, with a general longitudinal slope of

0.002 ft/ft between Highway 101 and Diablo Avenue to approximately 0.0001 ft/ft near the mouth. These slopes result in subcritical flows throughout the lower reach, even during storm events. However, critical and supercritical flows may occur in discrete locations during low tide conditions.

Novato Creek transitions from channel-control to tidal-control within this reach, as the slope of the creek reduces and the creek elevations come within San Pablo Bay tidal range. Tidal effects from San Pablo Bay become apparent and influence the stage of the creek, as the creek stage rises and falls with the tidal stage in San Pablo Bay. The location of the transition point from channel- to tidal-control varies with the magnitude of terrestrial inflows and tide stage characteristics.

Channel conveyance, and thus discharge capacity, in lower Novato Creek is directly related to the tide level. Since both the tide stage and inflows to Novato Creek vary with time, the channel conveyance also varies in time. Furthermore, since conveyance is a function of both terrestrial inflow and tide, peak stages in lower Novato Creek do not necessarily occur during the peak flow. The time-dependant effects of the changing inflows and tide (referred to as hydraulic boundary conditions) necessitate the application of a dynamic model to properly simulate the physical processes of tidally influenced, unsteady creek flow.

Although tidally influenced systems are unsteady by nature, steady-state hydraulic models, or models in which the boundary conditions do not vary with time, can be used to conservatively estimate water surface profiles and discharge in tidal channels. Steady-state models are simpler to operate and were more commonly applied prior to the advent of modern personal computers. Using HEC-2, a steady-state model developed by the Corps of Engineers, FEMA calculated a maximum channel conveyance capacity downstream of Highway 37 of 2,500 cfs (FEMA, 1989). It is worth noting that this is significantly less than the effective 10-year peak discharge of 3,420 cfs discharge published in the City of Novato FIS (FEMA, 1989).

The 1984 City of Novato Flood Insurance Rate Map published by FEMA indicates a nearly flat water surface coincident with the peak 100-year tidal stage in the lower reach of Novato Creek, revealing the dominance of tidal flooding over terrestrial flooding in Novato Creek downstream of Highway 37 for the one percent annual exceedance probability (100-year recurrence interval) flood. These predicted tide stages are based on tide stage frequency analyses conducted by the Corps. The 1989 City of Novato FIS rounds the Corps tidal flood stage of 6.5 feet NGVD 1929 to 7 feet NGVD 29 as per FEMA mapping guidelines (FEMA 2002).

Tides in San Pablo Bay follow a mixed semidiurnal cycle, with two high and two low tides, of differing heights, occurring in a single day. Due to geographic and hydrodynamic complexities, mean tide levels vary throughout the San Francisco Bay.. Tide cycles in San Pablo Bay lag those at the Golden Gate Bridge by as much as 75 minutes. Peak tide levels in the vicinity of Novato Creek are 6.0 ft NGVD 29 for the 10-year tide and 6.5 ft NGVD 29 for the 100-year tide (San Francisco District, 1984).

Storm events may lead to higher tidal stages than those predicted by gravitational forces for a variety of reasons. First, low barometric pressures associated with significant storms can cause an increase in tidal stage, as the ocean's surface level increases in response to the barometric low. Second, strong wind shear may push water towards land, leading to the phenomenon of a storm surge. Third, increases in large-scale regional runoff from the Sacramento and San Joaquin watersheds, as well as contributions from San Francisco Bay watersheds, can limit the low tidal excursion of normal tidal cycles. San Pablo Bay, for instance, is filled mainly by regional runoff and runoff from the Sacramento and San Joaquin River systems (Anderson et al., 2000).

Model Selection

The hydraulic modeling program UNET was utilized to evaluate the existing hydraulic conditions of lower Novato Creek, as well as evaluate the hydraulic conditions for the proposed project conditions. UNET is a one-dimensional model, developed by the U.S. Army Corps of Engineers, and provides a modeling framework for computing solutions to unsteady flow problems in channel networks. UNET also provides routines for evaluating levee overflow to floodplain storage, stage-discharge routing of bridges, culverts

and flap-gate culverts, and routing hydraulic linkages between main channel conveyance and overbank floodplain storage. These features make UNET an ideal tool for simulating the dynamic conditions within Novato Creek, as fluctuating tide levels in San Pablo Bay and the time dependent nature associated with storm hydrographs result in spatially and temporally variable hydraulic conditions. In addition, the relatively confined flow conditions exhibited by the Pacheco Pond-Novato Creek system are conducive to a one-dimensional analysis where connections between the main channel and storage areas are easily defined by discrete channel links. Finally, the use of UNET in a tidal environment is consistent with Corps and FEMA Guidelines (FEMA 2002). FEMA approves the use of one-dimensional unsteady flows in channel networks where flow reversals may occur and flood storage capacity must be considered.

Study Limits

The study domain used to assess the impacts of the proposed project alternatives extends from the mouth of Novato Creek upstream approximately 4 miles to the downstream face of the railroad bridge near Highway 37. Subcritical reaches are subject to downstream control, meaning that the hydraulic characteristics of a given cross section can affect stages that occur upstream. However, the distance that this effect propagates upstream is limited by channel slope and friction. This implies that if no increase in water surface elevation is calculated at the upstream study limit, then there will not be any increase in channel stage upstream of the study limit.

UNET Model Structure

UNET is an open channel network model that requires geometric data, friction coefficients, and boundary conditions as input. Using these input variable, the model solves the one-dimensional unsteady flow equations and calculates the flow magnitude and direction, water surface elevation at each cross section, and the storage characteristics of each storage area. For the impact analyses, the model geometry and boundary conditions are based on existing data.

Geometry

The study reaches include Pacheco Pond, Novato Creek, and the Bel Marin Keys V site. Network model geometries were developed by Bel from existing Light Detection and Radar (LiDAR), levee, and bathymetric surveys (Towill 1996). Since the model is designed to identify relative changes in hydraulic characteristics due to project features, several simplifying assumptions were made regarding Novato Creek's and Pacheco Pond's connections to adjacent areas. These include the assumption that flow from Novato Creek could only pass to the BMK V site and from Pacheco Pond through the flap gate connection. This allows for easily tracking changes in water surface elevations in Novato Creek due to project modifications by not simulating overtopping of levees into other adjacent areas such as the Antenna Fields north of Novato Creek. Furthermore, this assumption provides a conservative means to identify the project features' influence on water surface elevations.
The volume of flow overtopping the levee separating Pacheco Pond and the BMKV (at an elevation between 6 and 7 feet NGVD29) was investigated during initial sensitivity analyses. Approximately 14.4 acre-feet were calculated to flow over the levee into the BMKV site for the existing conditions geometry in Inflow Scenario A. This volume is approximately 0.6 percent of the inflowing volume to Pacheco Pond during Inflow Scenario A. Based on this analysis, weir flow over the levee was determined to be negligible with respect to the overflow volume's potential to increase flood stages.

Four geometric scenarios were developed to identify impacts on hydraulic characteristics along Novato Creek. These scenarios are summarized listed in Table 1 and graphically depicted in network schematic diagrams on Figure 2.

Water surface elevation and storage in Pacheco Pond and the Bel Marin Keys V site were simulated as storage areas in the UNET model. A lateral weir between Novato Creek and the Bel Marin Keys V site was defined to compute overflow and storage on the project site for existing conditions. From the existing LiDAR and survey data, cross sections, storage area stage-volume relationships, and lateral weir characteristics were defined. Using the LiDAR data, the Pacheco Pond storage volume between 0 and 7 feet NGVD was calculated to be 880 ac-ft. This volume is same as reported in Appendix IV in the Final Environmental Impact Report for Ignacio Industrial Park, Unit 3 (Madrone 1975) between 0 and 7 feet

MSL. Due to the ongoing changes in the terrain resulting from subsidence and channel evolution, it is not possible, nor is it necessarily required, to define present day geometric conditions precisely to identify the hydraulic impacts of the project on Novato Creek and Pacheco Pond.

The cross sections used in the model include the subtidal channel of the creek, adjacent marsh floodplain, and the existing levee structures. A cross section layout is shown in Figure 1. Top of levee surveys completed in 1996 (Towill 1996), indicate that the levee crest between Novato Creek and the Bel Marin Keys V site dips to an elevation of approximately 5.6-ft, NGVD 29, at a point approximately 1000 feet downstream from the Bel Marin Keys South Lagoon navigation lock. Overtopping of this levee was observed by Bel Marin Keys residents during the February 1998 flood event. Levee surveys of the Pacheco Pond outlet channel reveal low points at 5.6 and 6.7 ft NGVD 29. Based on these data, the baseline geometric condition considers the following features:

- Six 4-ft tall by 4-ft wide, unidirectional box culvert controls flow from Pacheco Pond to Novato Ck;
- 100-ft wide lateral weir at 5.6-ft, NGVD 29 for pond overflow into Novato Creek on Leveroni Parcel
- 1000-ft wide lateral weir at 6.7-ft, NGVD 29 for pond overflow into Novato Creek on Leveroni Parcel;
- 300-ft wide lateral weir at 5.6-ft, NGVD 29 for Novato Ck overflow to BMKV site approximately 1000 feet downstream of BMK community.

Table 1. Novato Creek Geometric Scenarios

Scenario	Model Conditions
Scenario 1: Existing Novato Creek and Pacheco Pond Network - **Evaluates the interaction between Pacheco Pond and Novato Creek for existing conditions**	Model Elements • **Six 4-ft tall by 4-ft wide, unidirectional box culvert controls flow from Pacheco Pond to Novato Ck;** • **100-ft wide lateral weir at 5.6-ft, NGVD 29 for Pacheco Pond overflow to Novato Creek on Leveroni parcel** • **1000-ft wide lateral weir at 6.7-ft, NGVD 29 for Pacheco Pond overflow to Novato Creek on Leveroni parcel** • **300-ft wide lateral weir at 5.6-ft, NGVD 29 for Novato Ck overflow to BMKV site approximately 1000 feet downstream of BMK community**
Scenario 2: No Pacheco Pond Outlet to Novato Creek and a Design Breach along BMKV -	Model Elements • **Pacheco Pond disconnected from Novato Creek;** • **right bank levee removed downstream of BMK Development** • **right bank floodplain expanded laterally by 1000-ft downstream of BMK Development to reflect opportunity for overflow into restored tidal marsh** • **600-acre tidal marsh modeled as storage area with hydraulic connection through new breach channel to lower Novato Creek.**
Scenario 3: Pacheco Pond Outlet to Novato Creek and a Design Breach -	Model Elements • **100-ft wide lateral weir at 5.6-ft, NGVD 29 for Pacheco Pond overflow to Novato Creek on Leveroni parcel** • **1000-ft wide lateral weir at 6.7-ft, NGVD 29 for Pacheco Pond overflow to Novato Creek on Leveroni parcel** • **Six 4-ft tall by 4-ft wide, unidirectional box culvert controls flow to tidal marsh** • **right bank levee removed downstream of BMK Development** • **right bank floodplain expanded laterally by 1000-ft downstream of BMKV swale to reflect opportunity for overflow into restored tidal marsh** • **600-acre tidal marsh modeled as storage area with hydraulic connection through new breach channel to lower Novato Creek.**
Scenario 4: No Pacheco Pond Outlet and No Design Breach along BMKV -	Model Elements • Connections between Pacheco Pond and Novato Creek Removed.

Hydraulic parameters in Pacheco Pond were estimated from geometric Scenarios 1, 3, 5, and 6. In Alternatives 1, 2, and 3 Pacheco Pond drains to the BMKV site and the outlet to Novato Creek is closed. Alternatives 1 and 3 were simulated by Geometric Scenarios 5 and Alternative 2 was simulated by Geometric Scenario 6. These scenarios are summarized in Table 2.

Scenario	Model Conditions
Scenario 5: Pacheco Pond Configuration for Alternatives 1 and 3 - **Evaluates an expanded Pacheco Pond with a flap gate outlet to the tidal marsh**	Model Elements • **Six 4-ft tall by 4-ft wide, unidirectional box culvert controls flow from Pacheco Pond to tidal marsh;** • **Pacheco Pond expanded to increase the pond surface area by 74 ac.**
Scenario 6: Pacheco Pond Configuration for Alternative 2 - **Evaluates an expanded Pacheco Pond with an adjacent seasonal marsh storage area, flow controlled by weir and flap gate structure**	Model Elements • **100 -ft weir controls flow from Pacheco Pond to seasonal wetland;** • **Six 4-ft tall by 4-ft wide, unidirectional box culvert controls flow from seasonal wetland to tidal marsh** • **Seasonal wetland surface area 135 ac** • **Pacheco Pond surface area expanded by 32 ac.**

Boundary Conditions

Boundary conditions were developed at the upstream and downstream study limits. Two inflow scenarios were modeled loosely representing the 10- and 100-year flow events for existing conditions. Hydrologic Scenarios A and B use published 10-year and 100-year flood event hydrographs, respectively, from two previous Corps of Engineers studies (Corps of Engineers 1987, PWA 1998).

Tide measurements taken at the mouth of the Petaluma River were utilized to develop time series of tidal stage hydrographs at the mouth of Novato Creek. These data, completed as part of the San Francisco Airport runway expansion dredge material disposal studies, consist of tidal stage measurements recorded at 10-minute increments for approximately one month duration (14 June - 17 July 2000). Previous studies of Novato Creek indicate negligible differences between Novato Creek and Petaluma River tidal stage characteristics (PWA, 1998). To conservatively estimate tidal conditions during flood events, the tide data were modified in two ways to reflect extreme tidal conditions that occur during significant flood events. The first modification was to increase the observed peak tidal stage by one foot to reflect extreme high tides due to low atmospheric pressure and wind setup in the region. This is equivalent to coincident tidal stage boundary conditions frequently used by the Corps of Engineers and the FEMA for flood control design or flood hazard mapping studies on tidally influenced streams and rivers in the San Francisco Bay Area. The resulting peak tide was calculated to be 5.75 ft NGVD 29, 0.25 feet lower than the 10-year peak tide. The second modification was to truncate the low tide elevation at the mean tide level to represent limits on low tide excursion due to extreme regional, basin-wide runoff conditions (Anderson et al, 2000). The resulting tidal boundary condition is shown in Figure 3.

Theoretically, there are infinite phasing combinations between the peak tide elevation and the peak discharge hydrographs. To simplify the analysis, Pacheco Creek and Arroyo San Jose hydrographs were phased to be coincident with the higher high water tidal stage for all model runs. However, the phasing of the Novato Creek hydrograph was varied to investigate the effect of lag times on system. Due to the larger watershed dimensions, the peak discharge from Novato Creek would be expected to lag the Pacheco Pond peak discharges. Novato Creek hydrographs were developed using three different lag times relative to the peak hydrograph from the Pacheco Pond watershed: 0-hour lag time (i.e. coincident with the higher high water tide stage and other hydrographs), 6-hour lag time (i.e. 6 hours behind other hydrographs), and 12-hour lag time. The adjustment of phasing was only relevant to the model runs that evaluated the existing conditions, as Pacheco Pond flows are routed away from Novato Creek for all project condition scenarios.

Loss Coefficients

Channel friction is expressed in UNET using Manning's equation. The Manning's roughness coefficient was set at 0.02 for the subtidal channel and 0.04 for the salt marsh benches. These values were adopted

from calibrated UNET models of Sonoma Creek developed as part of the mitigation planning for the San Francisco Airport runway expansion studies.

Model Scenarios

Four geometric scenarios were run for each of the hydrologic flow scenarios to assess project impacts on Novato Creek. Pacheco Pond was connected to Novato Creek in scenarios 1 and 3. Two additional geometric scenarios of Pacheco Pond (scenarios 5 and 6) were defined to evaluate the impacts to Pacheco Pond water surface elevations by the project alternatives. In these scenarios the flap gate connection between Pacheco Pond and Novato Creek was closed, thus identifying the effects of diverting all flow to Bel Marin Keys V project site. However, it should be noted that a new water management scenario envisioned by the project includes dual use of the existing and new outlets to enhance water quality in Pacheco Pond. Project Alternatives 1 and 3 were modeled as one scenario and Alternative 2 was modeled as a separate scenario. The conditions for Pacheco Pond draining directly to the Bel Marin Keys V site are modeled as Scenarios 5 and 6, respectively. The characteristics of the geometric model scenarios are summarized in Table 2. Schematic diagrams of the hydraulic connections and storage areas are shown in Figure 2.

Table 2. Geometric Model Scenarios

Scenario	Description
1	Existing conditions Novato Creek connected to Pacheco Pond. No design breach between Novato Creek and BMKV
2	Alternative 2 No connection between Novato Creek and Pacheco Pond Design breach between Novato Creek and BMKV
3	Novato Creek connected to Pacheco Pond. Design breach between Novato Creek and BMKV
4	No connection between Novato Creek and Pacheco Pond No design breach between Novato Creek and BMKV
5	No connection between Novato Creek and Pacheco Pond Pacheco Pond expansion Pacheco Pond outlet to BMKV as described in Project Alternatives 1 and 3
6	No connection between Novato Creek and Pacheco Pond Pacheco Pond connected to expanded pond and seasonal wetland as described in Revised Alt. 2 Seasonal Wetland outlet to BMKV as described in Revised Alternative 2

Model Results

Summarized below are the model results for the hydraulic routing analyses. Values presented in the results section are intended for comparison purposes to identify relative changes in hydraulic parameters between project elements (i.e. Pacheco Pond removal and/or design breach). Comparisons of water surface stage, velocity, and flow were made between Geometric Scenarios for a each flow condition.

Project Impacts to Novato Creek Stage -The project's impact on stage was evaluated by reviewing time series of computed stage data at three locations along Novato Creek; the proposed design breach location (Section 2.8), downstream of the Pacheco Pond outlet (Section 8 ds), and at the upstream model cross section immediately downstream of Highway 37 (Section 10). Scenario 1, which is equivalent to existing conditions on Novato Creek with a flap gate connection to Pacheco Pond and no design breach to the Bel Marin Keys V site, was used as the baseline condition from which comparisons with Scenarios 2 through 4 were made. The comparisons are described below.

- **Impact of levee breach** - Addition of the design breach to the baseline condition modeled in Scenario 3 produces negligible changes in water surface elevations (i.e. 0.25 feet or less) at

Sections 2.8, 8 ds, and 10. The time series histories are shown on Figures 4 and 5 for Inflow Conditions A and B, respectively.

- **Impact of rerouting Pacheco Pond connection to Bel Marin Keys V project site** – Removal of Pacheco Pond in Scenario 2 reduced the flow into Novato Creek and increased the magnitude of flow recession during ebb tides. A small (<0.25 foot) reduction in peak water surface elevation was also computed at all points on Novato Creek. These results are summarized in Table 3.

The computed stage for Scenarios 1 and 3, Pacheco Pond connected to Novato Creek, are similar at Sections 2.8, 8 ds, and 10 as are Scenarios 2 and 4, without Pacheco Pond connected to Novato Creek. The rapid stage recession computed in Scenarios 2 and 4 results from the reduced flow into Novato Creek from Pacheco Pond. These observations hold true for both Inflow Condition A and B.

Table 3. Summary of Maximum Stages

Scenario	Flow Condition A			Flow Condition B		
	Sec 2.8 Stage, ft	Sec 8 d/s Stage, ft	Sec 10 Stage, ft	Sec 2.8 Stage, ft	Sec 8 d/s Stage, ft	Sec 10 Stage, ft
1	5.69	6.13	6.55	5.69	7.26	8.09
2	5.64	6.12	6.54	5.69	7.00	7.98
3	5.64	6.12	6.54	5.64	7.13	8.03
4	5.69	6.13	6.52	5.68	7.04	7.99

Project Impacts to Novato Creek Velocity - Impacts due to Pacheco Pond and the design breach on channel velocity were assessed in a similar manner as the stage impacts, and are summarized below.

- **Impact of levee breach** – The levee breach connection to the restored tidal wetland in Scenarios 2 and 3 shows a large change in the computed velocity time series at Section 2.8, located immediately downstream of the levee breach, when compared with Scenario 1. Higher magnitude ebb and flood velocities are created by increasing the tidal prism of the restored tidal wetland and connecting this tidal prism to Novato Creek. The levee breach has no appreciable effect on velocity magnitudes upstream of the design breach at Sections 8 ds and 10. A summary of the peak velocities calculated for each scenario is provided in Table 4. Time series are shown in Figure 6 and 7 for flow scenarios A and B, respectively.

- **Impact of removing Pacheco Pond** – Removal of Pacheco Pond flood flows to Novato Creek has a negligible impact of peak velocities (less than 0.5 fps) at Sections 8 and 10. The velocity time series at these locations indicate a more rapid recession of velocities when Pacheco Pond flows are removed from the Novato Creek system.

Table 4. Summary of Maximum Velocity

Scenario	Flow Condition A			Flow Condition B		
	Sec 2.8 Vel, fps	Sec 8 d/s Vel, fps	Sec 10 Vel, fps	Sec 2.8 Vel, fps	Sec 8 d/s Vel, fps	Sec 10 Vel, fps
1	3.72	4.04	4.24	4.93	5.40	5.85
2	5.30	3.20	4.41	5.33	5.47	5.97
3	5.33	3.91	4.41	5.32	5.47	5.97
4	3.53	3.31	4.26	4.78	5.26	5.88

Project Impacts to Novato Creek Flow Rate - Impacts due to Pacheco Pond and the design breach on channel flow rate were assessed in a similar manner as the stage impacts and velocity impacts, and are summarized below.

- **Impact of levee breach** – As shown in Figures 8 and 9, the levee breach has no appreciable effect on flows at Sections 8 ds and 10. Downstream of the design levee breach (Section 2.8), the computed flow rate for both ebb and flood tide conditions on Novato Creek increases due to the draining and filling of the tidal prism in the proposed tidal wetland.

- **Impact of removing Pacheco Pond** – Removal of Pacheco Pond flows reduces the peak flow on Novato Creek at Section 2.8 and 8 ds, as summarized in Table 5. These reductions in flow and volume are shown in the flow time series histories on Figures 8 and 9.

Table 5. Summary of Peak Novato Creek Flow

	Flow Condition A			Flow Condition B		
Scenario	Sec 2.8 Flow, cfs	Sec 8 d/s Flow, cfs	Sec 10 Flow, cfs	Sec 2.8 Flow, cfs	Sec 8 d/s Flow, cfs	Sec 10 Flow, cfs
1	3230	2180	1740	4710	3870	3740
2	5180	1760	1740	5910	3490	3740
3	5180	2140	1740	5180	3810	3740
4	3270	1770	1740	4460	3480	3740

Project Impacts to Pacheco Pond Stage – The stage of Pacheco Pond was computed for all geometric and hydrologic scenarios. The proposed rerouting and expansion of Pacheco Pond substantially reduces the peak water surface elevation within Pacheco Pond (Table 6). Reducing stage in Pacheco Pond would improve the drainage of Ignacio Business Park and other low-lying areas adjacent to lower Arroyo San Jose, such as the nearby trailer park. The magnitude and extent of this improvement, however, was not quantified in this analysis.

Table 6. Peak Water Surface Elevations in Pacheco Pond (ft, NGVD 29)

Case	Scenario A	Scenario B
Existing	6.4	7.6
Alternative 1 & 3	4.5	7.2
Revised Alternative 2	4.6	6.3

The volume of water overtopping the Bel Marin Keys V levee from Novato Creek during the Scenario 1 (existing condition) Flow Condition A, which loosely represents the current 100-year Novato Creek flood, is 5 ac-ft. The duration of overtopping is less than 2 hours and has a peak discharge over the levee top of less than 60 cfs. The flow overtopping into the BMKV site during Scenario 1 Flow Condition A is less than 0.2 percent of the inflow hydrograph at the upstream Novato Creek boundary (Section 10).

Conclusion

The proposed levee breach and potential diversion of Pacheco Pond inflows reduces peak water surface stages in Novato Creek. The proposed tidal wetland connection to Novato Creek slightly increases channel velocity downstream of the proposed levee breach. Rerouting of Pacheco Pond reduces the duration of high velocities above the levee breach during the infrequent flood flows (approximately 1 in 10 or 100 years) modeled for this study. As described in the memorandum titled *Novato Creek Geomorphic and Hydraulic Modeling Technical* (Bel 2002b) hydraulic properties associated with daily tidal cycles are the dominant influence on tidal channel morphology. The proposed project will have no measurable impact on tidal hydraulics upstream of the design breach and will increase the tidal prism downstream of the design breach. This increase in tidal prism results in an increase in the channel dimensions downstream of the breach. The results indicate a reduction in stage on Novato Creek for all project conditions. The project alternatives all resulted in a reduction in flood stage on Novato Creek. The volume of overtopping into the BMKV levee from Novato Creek under existing conditions is negligible, and has no measurable impact on flood stage reduction on Novato Creek.

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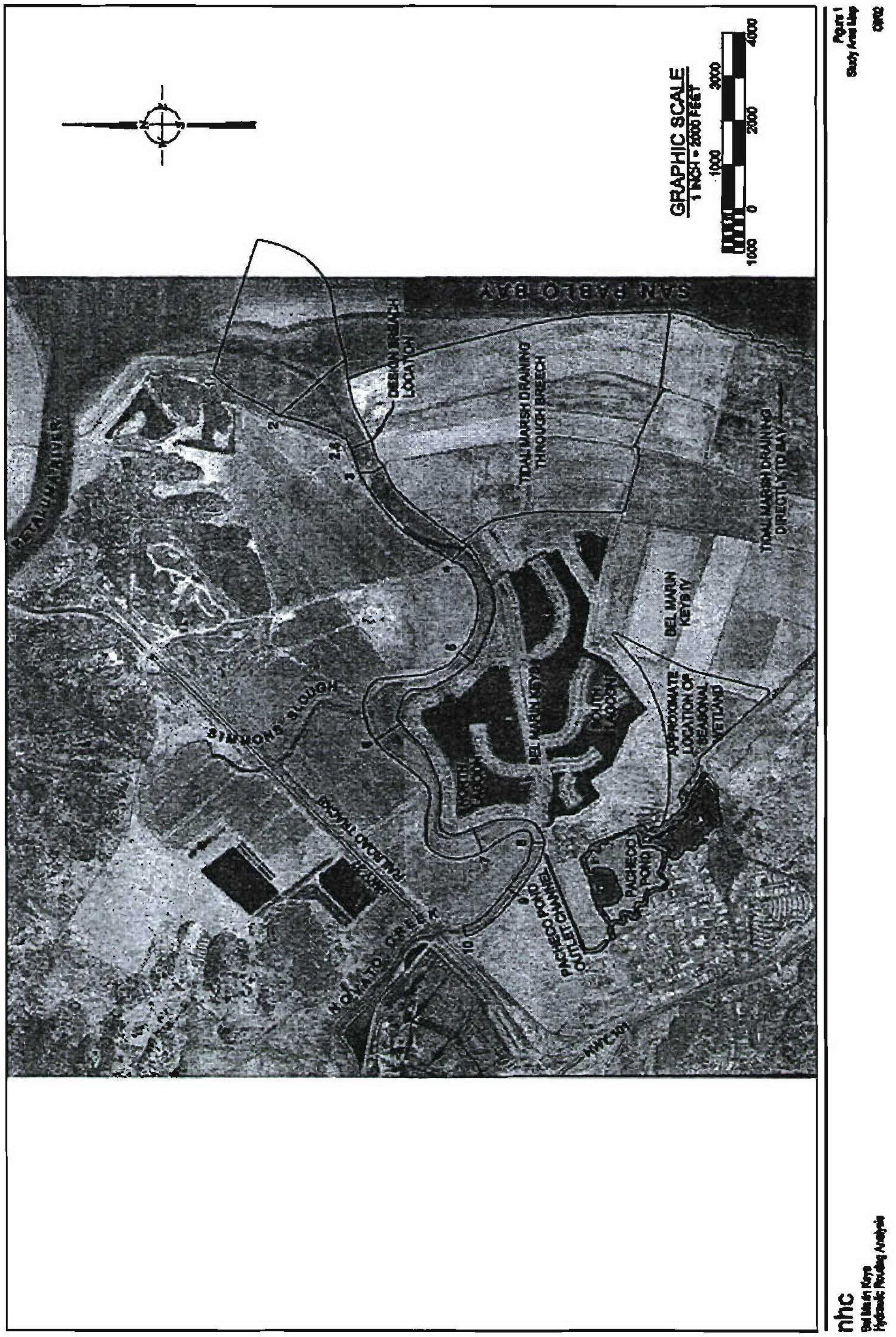

GRAPHIC SCALE
1 INCH = 2000 FEET
SAN PABLO BAY
DESIGN BREACH LOCATION
TIDAL MARSH DRAINING THROUGH BREECH
TIDAL MARSH DRAINING DIRECTLY TO BAY
BEL MARIN KEYS IV
APPROXIMATE LOCATION OF SEASONAL WETLAND
SIMMONS SLOUGH
NOVATO CREEK
PACHECO POND
PACHECO POND OUTLET CHANNEL
PETALUMA RIVER
nhc
Bel Marin Keys
Hydraulic Routing Analysis
Figure 1
Study Area Map

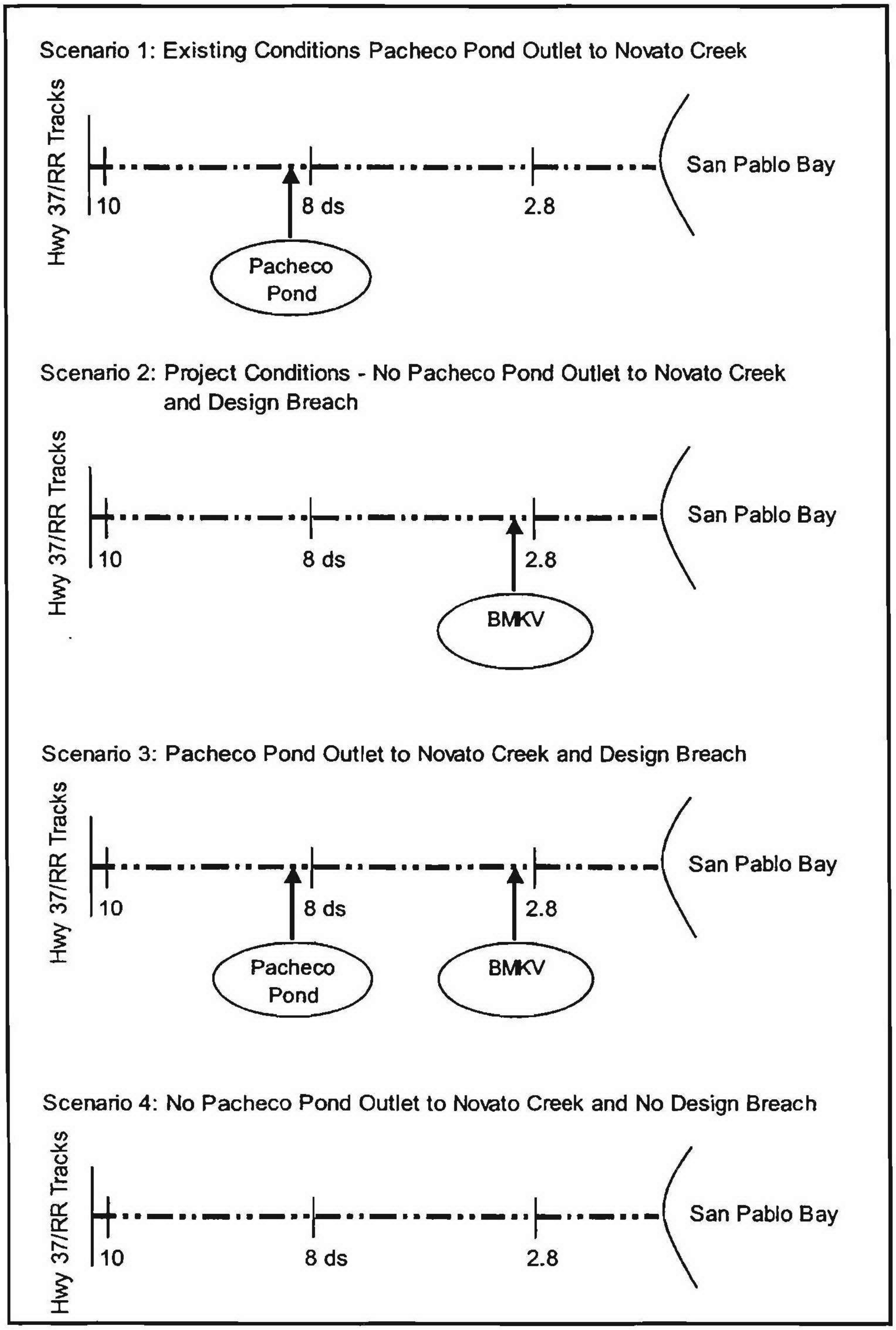


Figure 2. Geometric Scenario Schematic Diagrams

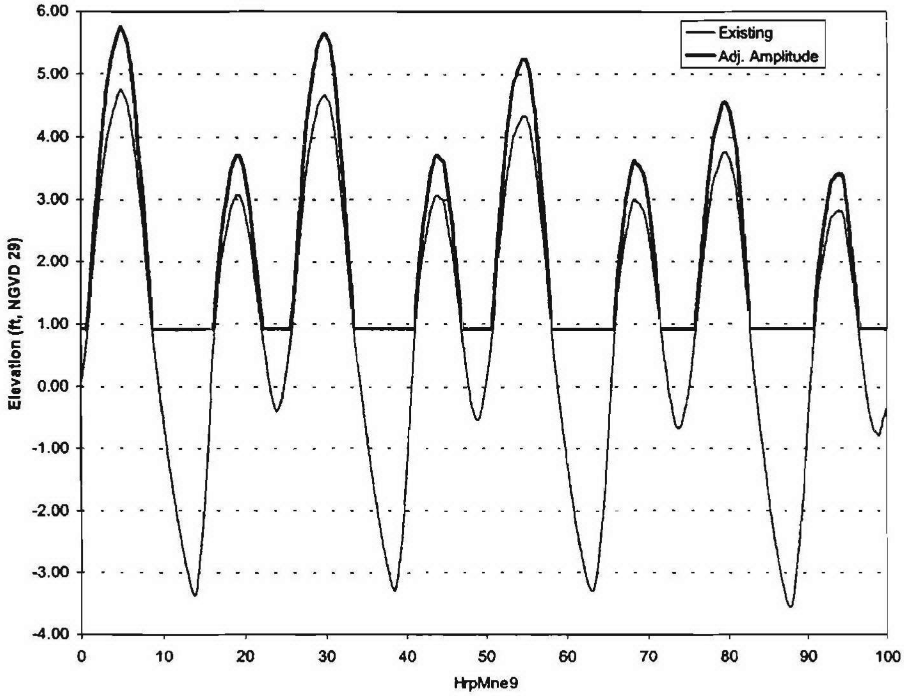
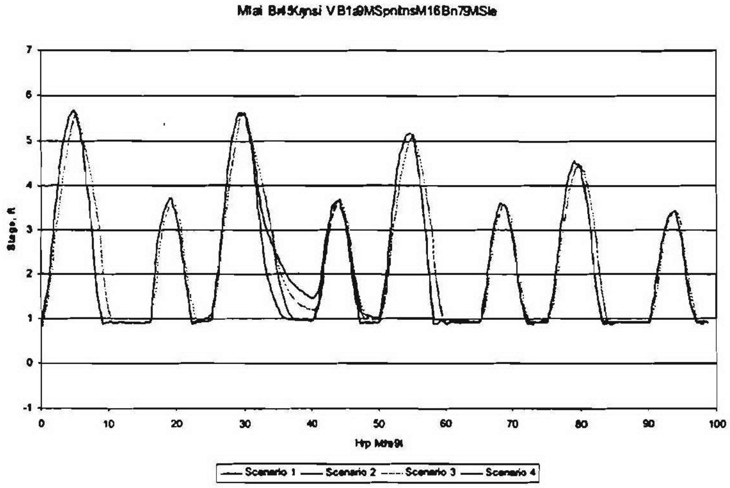
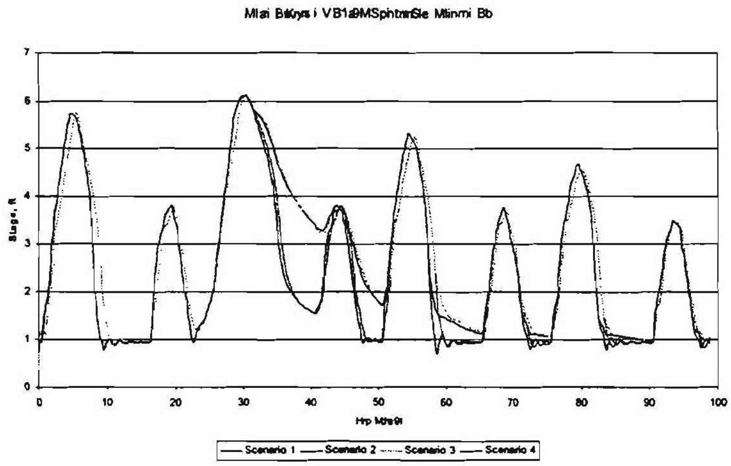


Figure 3. Tidal Boundary Condition





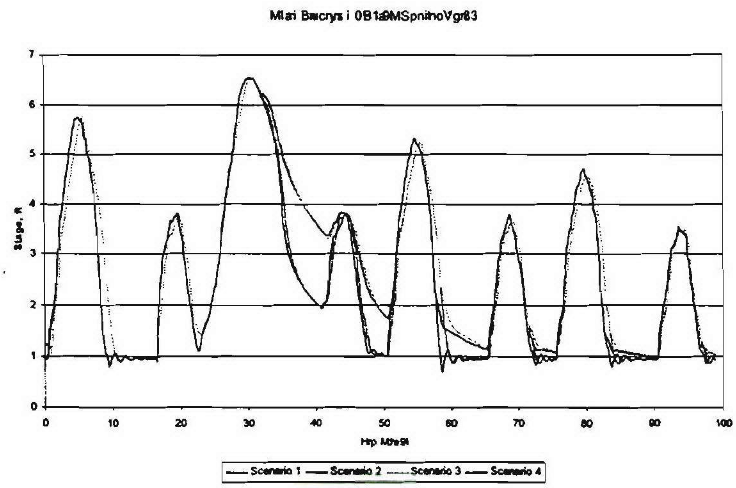


Figure 4. Stage Time Series Histories for Flow Condition A

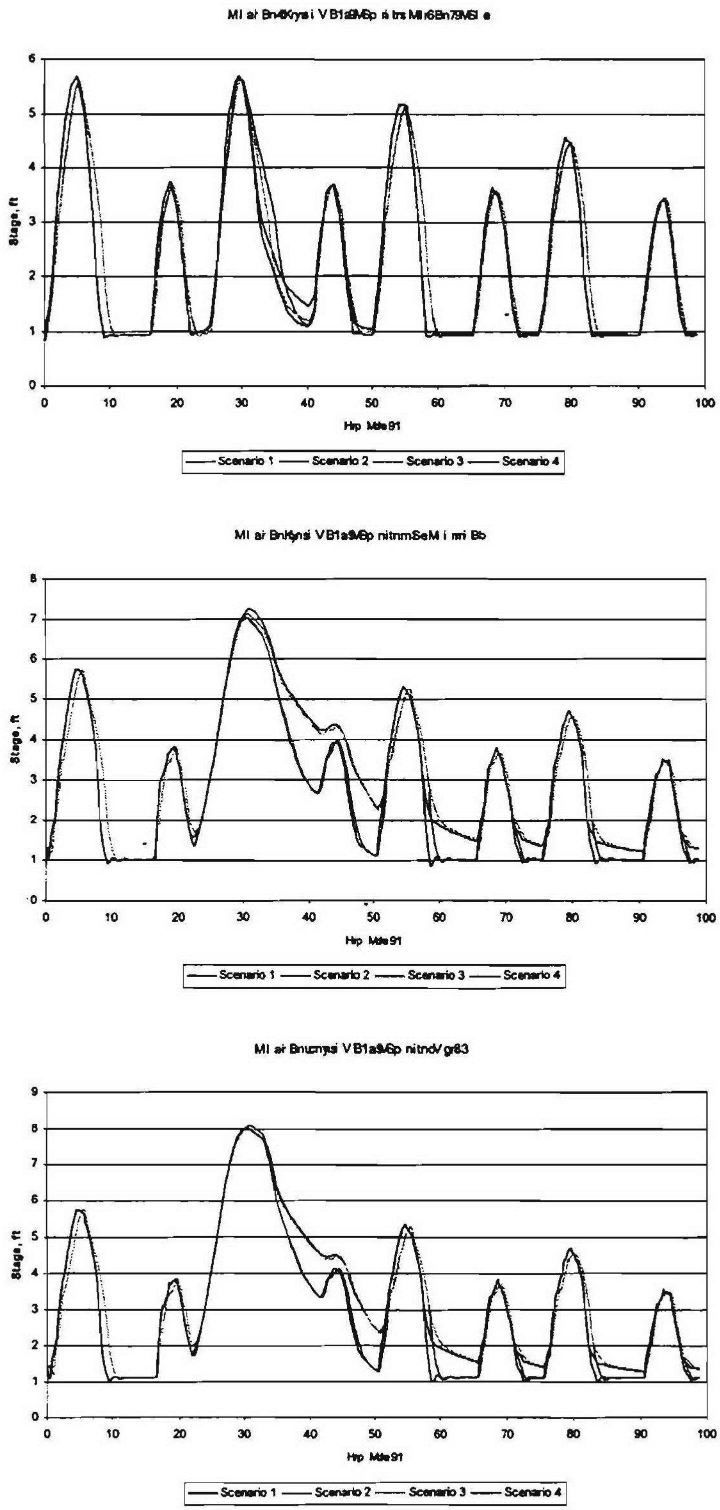


Figure 5. Stage Time Series Histories for Flow Condition B

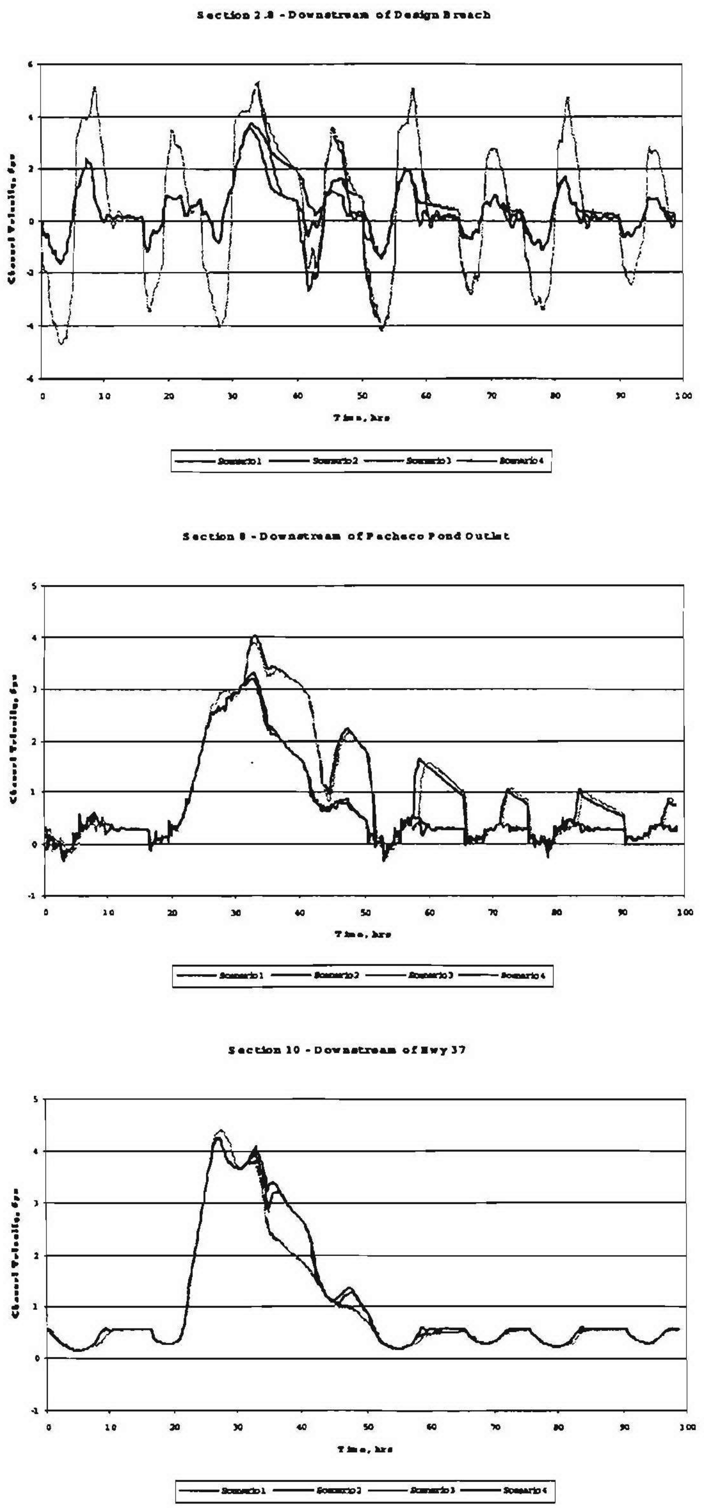


Figure 6. Velocity Time Series Histories for Flow Condition A

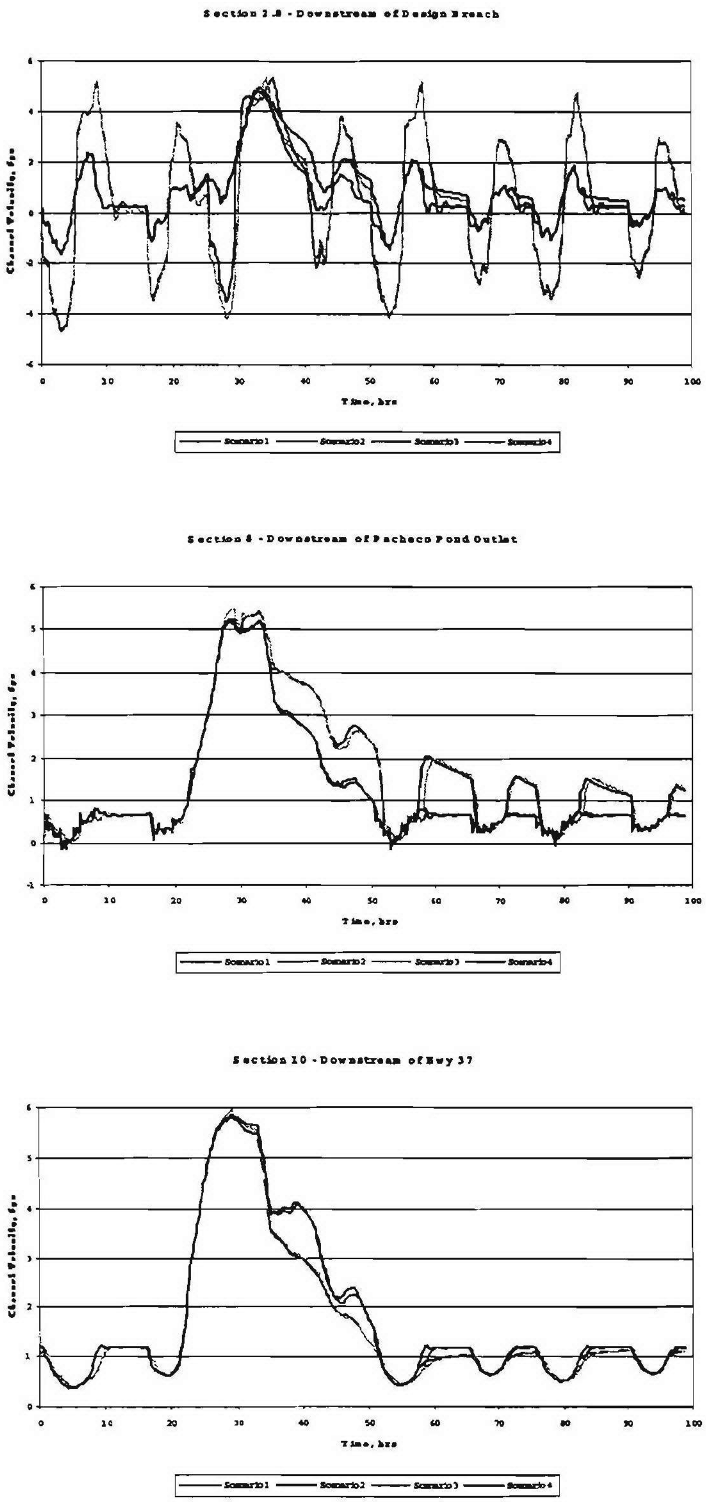


Figure 7. Velocity Time Series Histories for Flow Condition B

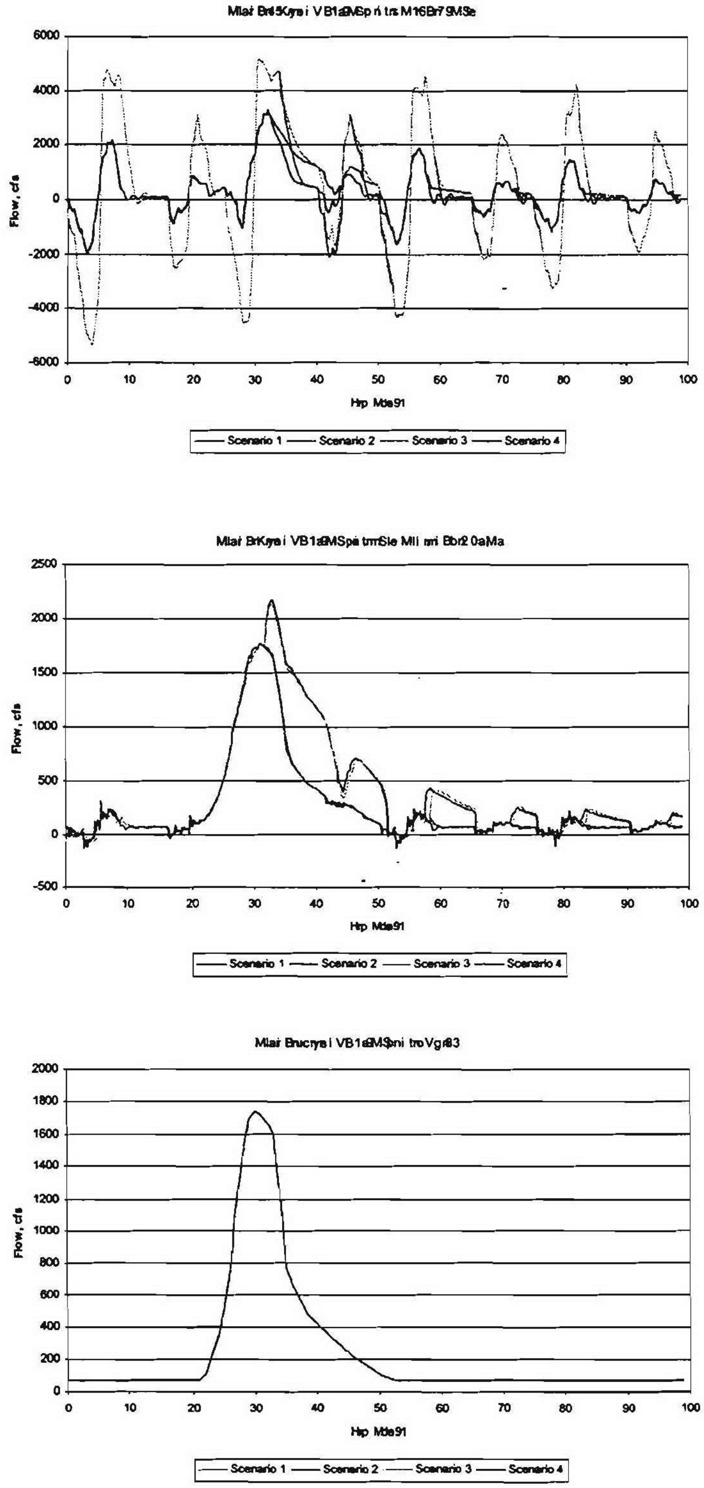


Figure 8. Hydrographs for Flow Condition A

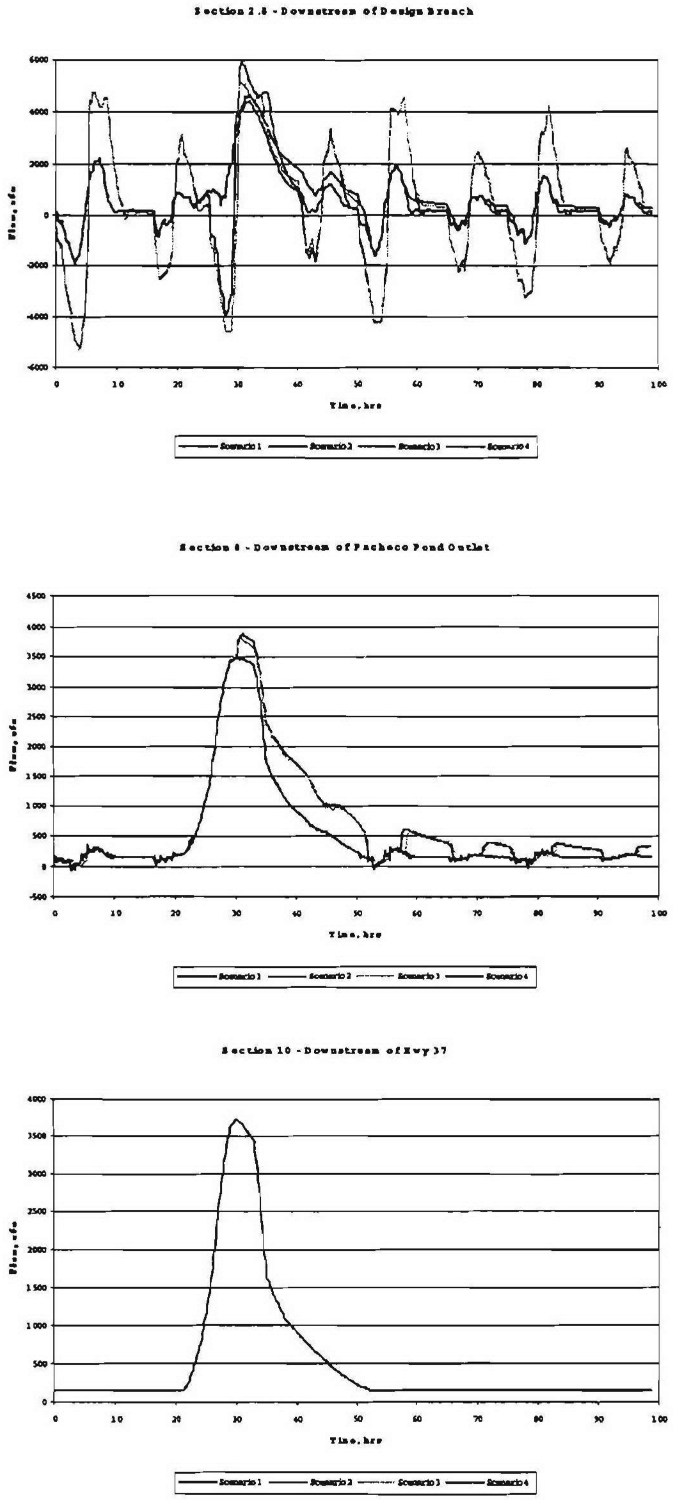


Figure 9. Hydrographs for Flow Condition B

Memorandum

northwest hydraulic consultants
3950 industrial boulevard, suite 100c
west sacramento, ca 95691
(916) 371-7400
(916) 371-7475 (fax)

Date:	October 14, 2002	Project: 50283
To:	Rich Walter	
Company/Agency:	Jones & Stokes	
From:	Brad Hall	
Subject:	Bel Marin Keys EIR Background Study	

Novato Creek Geomorphic and Hydraulic Modeling

The Bel Marin Keys (BMK) conceptual design plans call for a breach in the Novato Creek containment levee to provide tidal exchange to a proposed marsh basin near the mouth of the creek. The addition of 400 to 600 acres of tidal marsh to the existing system would enlarge the tidal prism of the creek and increase the tidal discharge in the channel reach between the breach and San Pablo Bay. To better understand the effects of the proposed breach, an unsteady hydraulic model of Novato Creek was developed and tested. Also, an empirical investigation of the surrounding tidal mudflat channel and shoals at the mouth of the creek was implemented. This memorandum discusses the background, methodology, and general results of these investigations.

Novato Creek Modeling Approach

UNET, a one-dimensional hydraulic model developed by the U.S. Army Corps of Engineers, was used to determine channel velocities in Novato Creek from tidal exchange. The marsh basin was specified as a storage area connected to the creek by the levee breach. The time series tide data used for the analysis were measured by ADEC and obtained at the mouth of the Petaluma River. Measurements were taken at 10-minute intervals over a full month period during the summer of 2000. The data was adjusted slightly so that mean sea level of the data correlated with the observed mean sea level of San Pablo Bay at the mouth of the Petaluma River (0.62 feet NGVD). No adjustments were made to the data to account for frequency or lag effects.

Cross sections for Novato Creek were developed from an algorithm that related slough channel top width to channel side slope and base width. This relationship was created by Northwest Hydraulic Consultants using data from various sloughs and channels located in the San Francisco Bay area, including Novato Creek. The equations relating the hydraulic parameters were of the form:

$$m = m_1 T^{m_2} \tag{1}$$

$$b = b_1 T \tag{2}$$

where *m* and *b* are the typical channel side slope and base width, respectively, associated with a top width *T*. The constants m_1, m_2, and b_1 were determined to be 0.13, 0.67, and 0.5, respectively, such that the hydraulic characteristics of the predicted and observed cross sections were as similar as possible. Equations 1 and 2 were then used to estimate the existing and likely future geometries of Novato Creek during the hydraulic and geomorphic modeling processes. Top widths on Novato Creek and other tidal sloughs adjacent to San Pablo Bay were measured from infrared aerial photographs taken by Air Flight Services in September of 2000.

The modeling procedure for estimating the widening of Novato Creek was an iterative process. Using the 30-day tide data and UNET, channel velocities and water surface profiles were calculated in the creek. This information was used to estimate shear stresses that developed along the channel boundary at each time step. Each value of computed shear stress, in turn, was used to estimate the incremental erosion that would take place along the channel according to the empirical equation:

$$E = M \frac{\tau - \tau_{cr}}{\tau_{cr}} \tag{3}$$

where *E* is the erosion rate, τ is the average boundary shear stress at a cross section, τ_{cr} is the critical shear stress for erosion, and *M* is an erosion coefficient.

A wide range of values is presented in the literature for the erosion coefficient. The values ranged from a low of 0.003 g/m^2sec found by Mehta et al. (1994) to a high of 5.0 g/m^2sec calculated by Ariathruai and Arulanandan (1978). In an effort to establish a suitable value for *M*, erosion data were obtained from slough channels between the years of 1994 to 1998 at Sonoma Baylands (Phillip Williams and Associates, 1999) and 1997 to 1999 at the Oro Loma Marsh (Lenington, 2001). From analysis of the data, an erosion constant of $M = 0.015$ g/m^2sec was established, which produced erosion rates of about 0.5 to 3 feet per year in channels with peak velocities between 3.5 and 6 feet per second.

Critical shear stress is a function of many variables including the physical and chemical properties of the eroded soil, and density and type of vegetative cover.

A midrange value of τ_{cr}=0.75 N/m^2 was adopted as a reasonable compromise. This value also produced modeling results that agreed well with the stable channel threshold velocity range of 2.5 to 3 feet per second.

Channel roughness in UNET is modeled using the Manning Equation and an associated Manning's 'n' coefficient. The coefficient accounts for hydraulic energy losses due to friction, which are responsible for the phenomenon of tidal muting. An appropriate value for Manning's n was developed using both published values and an empirical calibration of the Skaggs Island UNET model. Weisman et al. (1989) calculated coefficient values that ranged between 0.0125 and 0.0202. Chow (1959) listed values of 0.020 to 0.025 for channels made of fine silts and clays. Barnes (1967) suggested a value of n=0.026 for the Indian Fork River, which has a clay channel and a flat slope. Leopold et al. (1993) found somewhat higher roughness values for local tidal channels that ranged between 0.028 and 0.063.

For this study, Manning's n was determined by trial and error using tide data collected by ADEC (2000) and Warner and Schoellhamer (1999). Both data sets include tide data collected at the lower end of Sonoma Creek and at Hudeman Slough at the northern end of Skaggs Island. The data indicate that full tidal exchange occurs at both stations, with a lag time of about 30 to 40 minutes. With this in mind, a UNET model of the existing slough network around Skaggs Island was developed specifically to calibrate Manning's n for the system. By trial and error, it was observed that tidal muting disappeared in the model when using a roughness coefficient of n=0.02. This value was, therefore, defined as the slough channel roughness coefficient. The marsh plains were assumed to be much rougher than the channels due to dense vegetation and variable topography. A value of n=0.04 was assigned to these areas according to Barnes (1967), Chow (1959), and engineering judgment. UNET model results were relatively insensitive to the value of the marsh plain roughness.

Mudflat Modeling Approach

To estimate the potential effects of the proposed restoration on the mudflats, or shoals, at the mouth of Novato, a study of existing mudflat channels was performed. This study consisted of using bathymetric data and newly established transects in established mudflat channels around the bay to develop a relationship between mudflat channel top width and upstream tidal prism volume.

Typical mud flat cross sections were selected where the average mud flat elevation was approximately -0.5 m, NGVD 29. Tidal prism volumes in the upstream basins were estimated using the planform area of the observed channels multiplied by the vertical range in tides (MHHW to MLLW). Figure 1 presents the relationship observed between mud flat channel width and upstream

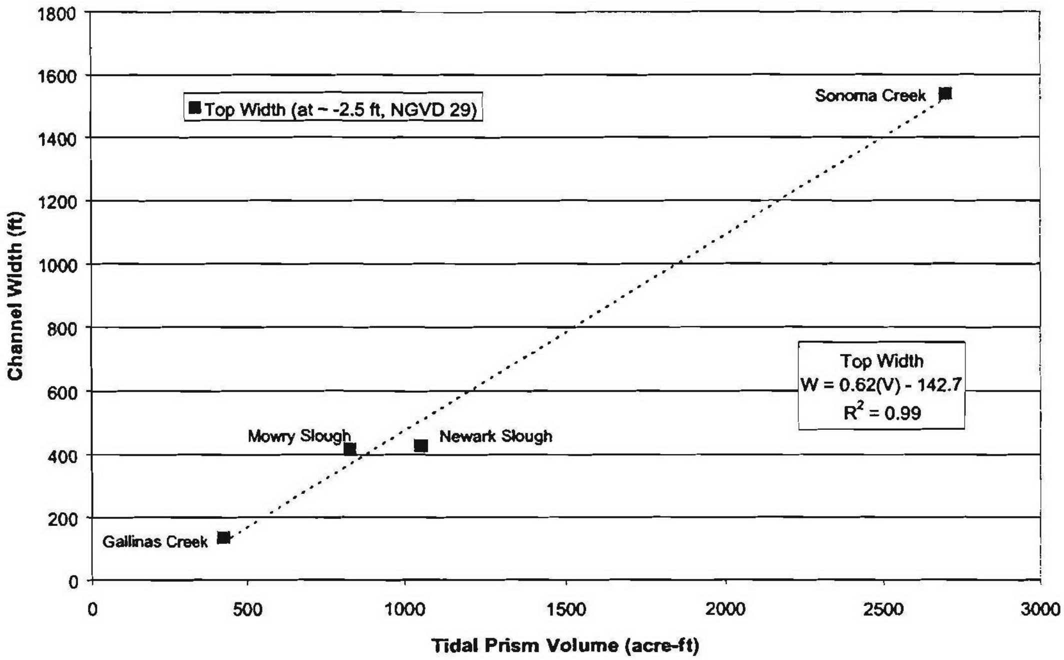


Figure 1. Mudflat channel width as a function of upstream tidal prism volume.

tidal prism volume. A best-fit line was added to the data points to correlate mud flat channel size to basin volume. Because the relationship presented in Figure 1 is linear, an increase in basin volume should result in a proportional increase in mudflat channel top width. The estimated volume of the proposed marsh basin is about 800 acre-feet at MHHW, assuming equilibrium marsh plain elevations. According to Figure 1, this corresponds to a mudflat channel width increase of between 250 to 350 feet. The total length of the mudflat channel is approximately 2000 feet.

Modeling Results and Discussion

The hydraulic and geomorphic modeling of the lower Novato Creek suggested that the 140-foot wide channel downstream of the breach would increase by 10 to 40 feet in width and about a half to one foot in depth due to the addition of the proposed marsh basin connection. This corresponds to about 2 to 5 acres of eroded marsh flood plain. The shoal analysis predicted a loss of approximately 10 to 15 acres of existing mudflat due to the basin connection, which would likely occur along the sides of the mudflat channel. The invert elevation of the mudflat channel may also decrease slightly due to the addition of the marsh basin. The marsh restoration project is expected to develop 400 to 600 acres of new tidal marsh connected to Novato Creek and over 50 acres of new fringe mud flat. Therefore, these impacts are considered to be less than significant.

The erosion of the Novato Creek channel downstream of the levee breach would occur slowly over time due to increases in flow and channel velocity. The

hydraulic model predicted a peak tidal flow increase from an existing 1500 cfs to between 3000 and 5000 cfs with the breach in place. Velocity increases will be most apparent immediately downstream of the breach where the channel width is most constricted. Existing peak tidal velocities of 2 feet per second will increase to 4 to 6 feet per second in some sections for existing Novato Creek channel configurations. This increased velocity is contained to the subtidal channel section, and leads to the predicted widening of the lowermost tidally influenced reach of Novato Creek. Because the perimeter levees are set back from the main channel near the mouth of the creek, and because the flow is forced over an elevated and highly roughened flood plain during high tides, the velocity increases near the levee due to the breach would be negligible or zero. Therefore, the increase in channel velocity would not threaten the structural integrity of the confining levees.

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Appendix F

Real Estate Plan

HAMILTON ARMY AIRFIELD WETLAND RESTORATION
DRAFT GENERAL REEVALUATION REPORT
TO INCORPORATE BEL MARIN KEYS V
NOVATO, CALIFORNIA

REAL ESTATE PLAN

General Project Description

The purpose of this project is to increase the ability of the Hamilton Wetlands Restoration Project to beneficially reuse dredged material and to provide endangered species habitat. The Bel Marin Keys V (BMKV) parcel would also increase operational flexibility. The addition of the BMKV parcel is the purpose of the General Reevaluation Report (GRR) to the Hamilton Wetlands Restoration Project (HWRP). This would expand the existing authorized HWRP to include the BMKV area. There is also an area consisting of two acres that is required for a kiosk, parking, and restrooms. There is also a Bay Trail component to the project, which is incorporated into the BMKV parcel area.

This Real Estate Plan is an appendix to the GRR. A conceptual restoration plan, feasibility study, and environmental impact report/environmental impact study (EIR/EIS) were completed in December 1998 for the 101(b)(3) of WRDA 1999, which approved a project at Hamilton Airfield "substantially in accordance with" plans recommended in a final report of the Chief of Engineers. Legislative authorization was made contingent to issuance of a favorable report by 31 December 1999. The total cost of HWRP authorized in WRDA 1999 was $55.2M. The Chief's Report was signed on 3 August 1999. The Hamilton Project is presently in final engineering design, and initial construction is expected to commence in summer of 2002. A Real Estate Plan was prepared for the HWRP Feasibility Report. Following are the real estate requirements and the valuation included in that report:

Feature	Estate	Owner	Acreage
Wetland Site	Fee	Army	644.19 acres
Wetland Site	Fee	SLC	318.62 acres
Wetland Site	Fee	*Navy	18.37 acres
Levee	Levee Easement	City of Novato	5.59 acres
Pipeline	Pipeline Easement	Navigation Servitude	0.76 acre

*The Navy quitclaimed part of the 18.37 acres to the City of Novato. Part of the area quitclaimed, .69 acre will need to be conveyed to the State Coastal Conservancy (NFS). The City of Novato will quitclaim this land to the NFS.

TOTAL VALUATION OF REQUIRED LANDS - $80,743.00 per Feasibility Report and with consideration that the NFS would not receive credit for Federal lands that they receive at no cost.

The Corps and the State Coastal Conservancy (SCC), the non-Federal sponsor (NFS), in collaboration with the San Francisco Bay Conservation and Development Commission (BCDC), is seeking to restore a 1610-acre site, BMKV for an expansion of the Hamilton Wetlands Project at Hamilton Army Airfield (HAAF). This effort has been undertaken by the completion of a Section 204 Initial Appraisal Report (IAR), which was completed in September 2000. This draft report is now underway for the purposes of obtaining WRDA '02 authorization.

Description of Project Area

The project area, BMKV, is a 1610-acre parcel that lies in an unincorporated area southeast of Novato, Marin County, California. The parcel is bounded by an existing residential development and Novato Creek to the north, San Pablo Bay to the east, Pacheco Pond to the west, and Hamilton Army Airfield to the south. There is also a two-acre parcel adjacent to the west side of HWRP (panhandle area) that will accommodate a kiosk, parking, and restrooms. The BMKV site historically supported tidal wetland habitat. However, during the late 1800's, levees were constructed to separate the site from the tidal influence of San Pablo Bay permitting agricultural use. The area has remained in cultivation since that time and now supports hay production. Over the last century, the site has subsided to an elevation below mean sea level. There are numerous flood and drainage easements and Marin County flood zoning ordinances and codes. The NFS acquired the property with such encumbrances. They do not have any impact on the potential use of the property. A portion of the BMKV site was in the early stages of a housing development, and lands had been developed for such subdividing when the owner, California Quartet, met with resistance from Marin County. The SCC purchased the BMKV property for the purpose of habitat restoration and with the intent of including this area as an expansion of the HWRP.

National Ecosystem Restoration (NER) Plan

This Real Estate Plan is in support of an environmental restoration project and, therefore, does not consider a National Economic Development Plan. ER-1105-2-100 states "Ecosystem restoration is one of the primary missions of the Corps of Engineers Civil Works program. The Corps' objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER). ... Single purpose ecosystem restoration plans shall be formulated and evaluated in terms of their net contributions to increases in ecosystem value (NER) outputs, expressed in non-monetary units..."

NER PLAN DESCRIPTION

Alternative 2 is the NER. The selected alternative provides two tidal wetland cells with breaches to San Pablo Bay and Novato Creek, seasonal wetland and upland habitat, 21-acre expansion to Pacheco Pond, flood storage for BMK South Lagoon and beneficially re-uses 17.3 MCY of dredged material. Tidal (tidal marsh, tidal flat, subtidal) and nontidal (high-transitional marsh, seasonal wetlands, upland) habitat types would be restored to the expansion site (BMKV). Imported dredged material (determined to be suitable wetland cover material based on DMMO requirements) would be used to create upland and seasonal wetland habitats, and to create surface elevations suitable to accelerate the establishment of tidal marsh vegetation. Final marsh plain elevations would develop over time through the natural deposition of sediments from San Pablo Bay, supporting the establishment of tidal marsh vegetation. There will also be a cost shared recreation feature which will include an area, comprised on 2 acres and located adjacent to the west side of the HWRP (panhandle area), for a kiosk, parking, and restroom area. The recreation feature will also include a Bay Trail that will be located on the BMKV parcel and along the HWRP and the Navy Ball Fields 3 & 4.

Total Lands Required for BMKV Increment to HWRP

Feature – Wetland Site
Acres –1610-acre parcel
Estate – Fee
Owner – State Coastal Conservancy (NFS)
Feature – Recreation Area
Acres - 2 acres - for recreation (site for kiosk, parking, and restroom area)
Estate – Fee
Owner– City of Novato
Feature – Recreation Bay Trail
Acres - Included on 1610-acre site owned by State Coastal Conservancy and along the southern boundary of the HWRP parcel and along the Navy Ball Fields 3 & 4.
Estate – Fee
Owner – State Coastal Conservancy owns the 1610 site, and Navy owns the Ball Fields 3 & 4, which they will provide to the NFS in a Public Benefit Conveyance. This is in accordance with the authorized HWRP.

Sponsor Provided Lands

Sponsor will provide the 1610 acres for the wetland site, the 2-acre site for the recreation feature, and the .69-acre required for the HWRP. Subsequent to the authorization of the HWRP, the Navy quitclaimed .69-acre of the Navy Ball Fields to the City of Novato. The City of Novato agrees to transfer this .69-acre to the NFS.

Estates

The only estate required for the BMKV increment/addition to the HWRP is fee. There is no request for approval of a non-standard estate.

Baseline Cost Estimate

A gross appraisal was prepared for this property at the October 2001 price levels. The land cost estimates are based on this report. All lands, regardless of ownership, have been estimated at fair market value. There is no difference between State and Federal rules in the valuation of the lands to be acquired.

Project	Non-Federal	Federal	LERRDS	Total
BMKV	$369,200	$164,000	$19,109,201	$19,642,401

Utility/Facility Relocations

There are five high voltage electric transmission line towers that are owned by Pacific Gas and Electric Company (PG&E) that will require "protection in place". This will involve these towers being jacketed with asphalt and concrete to minimize erosion and corrosion associated with tidal inundation. Utility service would not be interrupted during this activity. This work is a construction cost.

A new outfall pipeline would be installed along the levee (the existing alignment) that separates the project site from the adjacent HAAF parcel. This outfall pipe will replace the Novato Sanitary District's (NSD) existing outfall pipe, which will be abandoned in place. This utility was determined to be a utility relocation and approved as such in the authorized HWRP. This relocation was determined to be compensable and shall be cost shared as a LERRDs item. There is, however, the necessity for a realignment of the NSD pipeline due to the expanded Pacheco Pond area, which will require an extension of the NSD pipe of approximately 400 feet for the BMK project. This additional pipeline is considered a utility relocation, and an Attorney's Opinion of Compensability has been prepared which determined that this utility "relocation" is compensable and will consequently be cost shared under LERRDs.

"ANY CONCLUSION OR CATEGORIZATION CONTAINED IN THIS REPORT THAT AN ITEM IS A UTILITY OR FACILITY RELOCATION TO BE PERFORMED BY THE NON-FEDERAL SPONSOR AS PART OF ITS LERRD RESPONSIBILITIES IS PRELIMINARY ONLY. THE GOVERNMENT WILL MAKE A FINAL DETERMINATION OF THE RELOCATIONS NECESSARY FOR THE CONSTRUCTION, OPERATION, OR MAINTENANCE OF THE PROJECT AFTER FURTHER ANALYSIS AND COMPLETION AND APPROVAL OF FINAL ATTORNEY'S OPINIONS OF COMPENSABILITY FOR EACH OF THE IMPACTED UTILITIES AND FACILITIES."

Public Law 91-646, The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended by Public Law 100-17

There are no Public Law 91-646 Relocations involved in this proposed BMKV addition to the HWRP, nor are there any in the HWRP.

Non-Federal Sponsor's Ability to Acquire

The non-Federal sponsor is the State Coastal Conservancy (SCC) who is an agency of the State of California. The SCC has the authority pursuant to Division 21 of the California Public Resources Code to accept the dedication of fee title, easements, or other interests in lands whose reservation is required to meet the policies and objectives of the San Francisco Bay Plan and to acquire real property or any interests therein for the purposes including the restoration and enhancement of coastal resources, subject to the Director of General Services, pursuant to California Govt. Code Section 11005. The SCC does not have a real estate staff. The property acquisitions in this project involve transfers of property from the Army, State Lands Commission, U.S. Navy, and City of Novato. The NFS has already acquired the BMKV parcel. The SLC property may be acquired through eminent domain proceedings, or through another appropriate arrangement between the SLC and the non-Federal Sponsor, as will be determined at the time that the SLC parcel has been placed in a condition suitable for project implementation. The NFS will acquire the necessary two acres of land for the area required for the kiosk, parking, and restrooms from the City of Novato and the .69-acre area of the Navy Ball Fields 3 & 4 that were transferred to the City of Novato by the Navy. The NFS will acquire Ball Fields 3 & 4, with the exclusion of the .69-acre area mentioned above, through a Public Benefits Conveyance. This acquisition of the Ball Field area will be for the HWRP and is only mentioned in this BMKV report to clarify the change regarding the .69-acre site being quitclaimed to the City of Novato subsequent to the authorization of the HWRP.

Attitude of Landowners

The BMKV parcel is already owned by the State Coastal Conservancy (non-Federal sponsor). The City of Novato owns the two acres for the Recreation Area and the .69-acre of the Navy Ball Fields 3 & 4. The City of Novato has agreed to quitclaim these areas to the NFS. The NFS is obtaining a Public Benefit Conveyance from the Navy for the remaining area of the Navy Ball Fields 3 & 4, which is being coordinated. (The Ball Field lands pertain to the HWRP.)

Mitigation

This project is an environmental project and there are no features of the project that will require mitigation.

Hazardous, Toxic, and Radiological Waste (HTRW)

There has not been any detection of contaminates that would impact this project. There has been a Phase I and a Phase II Report done by the sponsor when they acquired the property. The California Department of Toxic Substances Control (DTSC) has not expressed any concerns.

Minerals

The sponsor will contact Bureau of Land Management for confirmation that there are no minerals. There are no valuable minerals impacted by this project. There was, therefore, no enhancement for mineral deposits included in the baseline cost estimate.

Project Map

A project map is attached to the Real Estate Plan.

Acquisition Schedule

An acquisition schedule is attached to this Real Estate Plan. The schedule has been coordinated with the Project Manager and the NFS.

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY

I. Legal Authority:

a. **Does the sponsor have legal authority to acquire and hold title to real property for project purposes?**
YES

b. **Does the sponsor have the power of eminent domain for this project?**
YES

c. **Does the sponsor have "quick-take" authority for this project?**
NO

d. **Are any of the lands/interests in land required for the project located outside the sponsor's political boundary?**
NO

e. **Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn?**

Yes, there are some areas owned by the Federal Government, but these will be acquired through the BRAC process and a PBC from the Navy.

II. Human Resource Requirements:

a. **Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including PL 91-646, as amended?**
NO

b. **If the answer to II. a. is "yes", has a reasonable plan been developed to provide such training?**
N/A

c. **Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project?**
YES

d. **Is the sponsor's projected in-house staffing level sufficient considering its other workload, if any, and the project schedule?**
NO

e. **Can the sponsor obtain contractor support, if required, in a timely fashion**
YES

f. **Will the sponsor likely request USACE assistance in acquiring real estate?**
Federal assistance may be requested and provided in the condemnation of the State Lands Commission parcel, referred to as the Antenna Field on the HWRP.

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site?
YES

b. Has the sponsor approved the project/real estate schedule/milestones?
The sponsor has approved the real estate schedule milestones.

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects?
YES

b. With regard to this project, the sponsor is anticipated to be:
(Capable – Highly Capable – Not capable, etc.)
Highly Capable

V. Coordination:

a. Has this assessment been coordinated with the sponsor?
YES

b. Does the sponsor concur with this assessment?
YES

Prepared by:

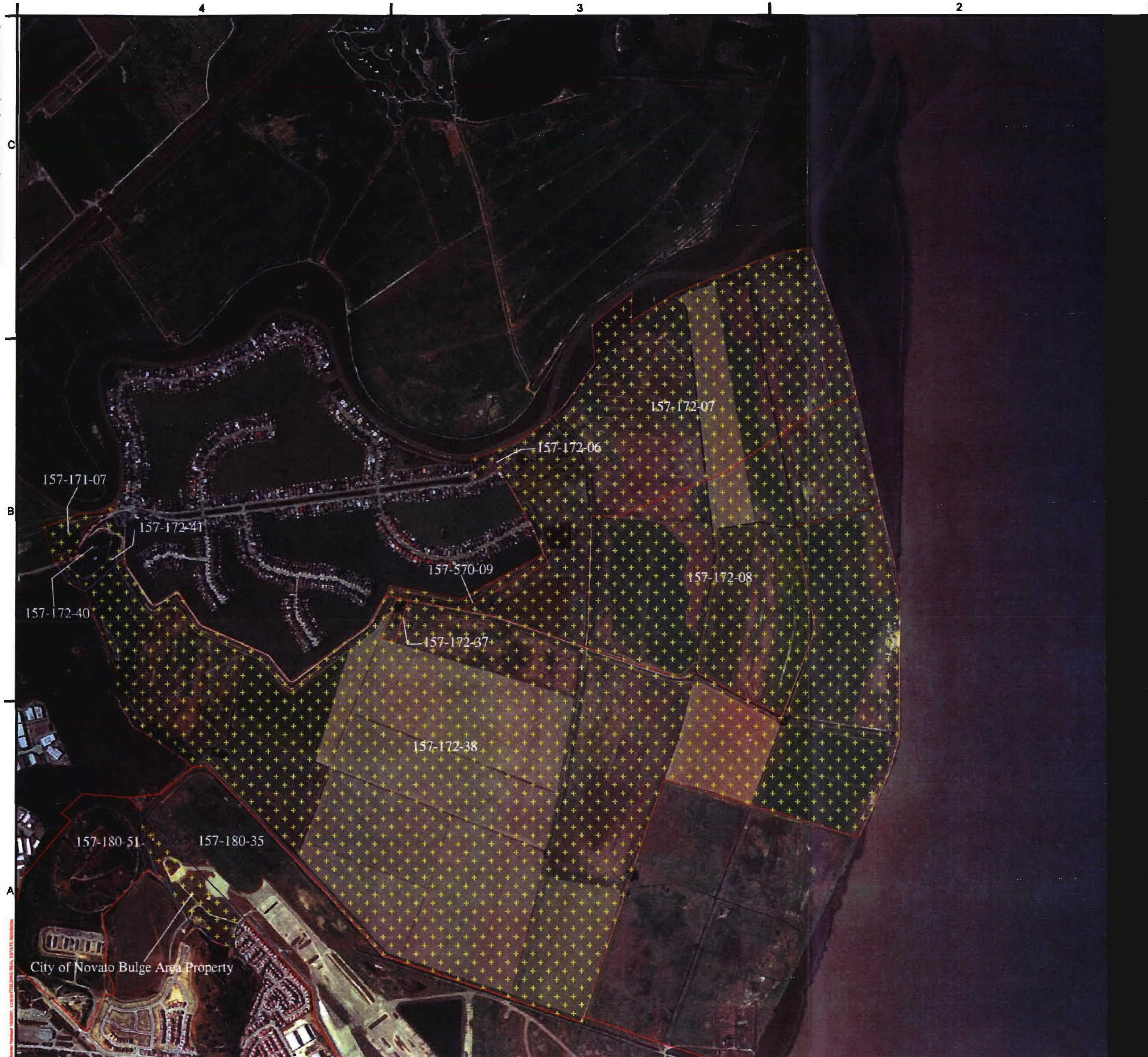
Susan Miller

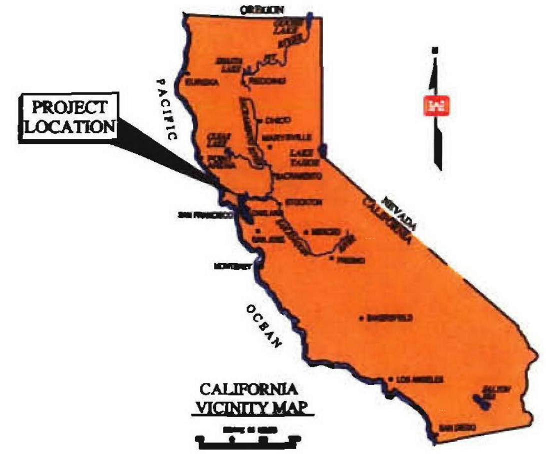
SUSAN MILLER
REAL ESTATE PROGRAM MANAGER

Reviewed and Approved by:

Marvin D. Fisher

MARVIN D. FISHER
Chief, Real Estate Division





CALIFORNIA VICINITY MAP

NOTE: The data is only a representation of features on the earth compiled by computer program from raw data obtained from different sources and is not necessarily, in whole or in part, based upon any physical recording, study or survey, professional or otherwise, of the covered property. This information is not intended as a substitute for a field survey by a licensed professional or any other use or application that requires legal or engineering accuracy.

DATUM: NORTH AMERICAN 1927
PROJECTION: STATE PLANE
ZONE: CALIFORNIA 3

LEGEND

- PROPERTY LINE
- 123-456-78 ASSESSOR PARCEL NUMBER
- PROPERTIES TO BE ADDED TO HAMILTON

BEL MARIN KEYS V PROPERTIES

PORTION OF RANCHO SAN JOSE
MARIN COUNTY, CALIFORNIA

US Army Corps of Engineers
Sacramento District

Symbol	Description	Date	Approved

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

PREPARED BY:
REAL ESTATE DIVISION
CADASTRAL SECTION
1325 'J' STREET
SACRAMENTO, CA 95814-2922

Mapping Lead: S. HICKS
Dsn by:
Spec No.:
Date Approved:
Rev.
Assisted by: L. GERRITY
Reviewed by: C. HIDALGO
Drawing Code:
Project Manager: SUSAN MILLER
File name: BMKMstr
Plot date: 05/07/02
Plot scale: 1:1

NOVATO CALIFORNIA
BEL MARIN KEYS V
ADDITION TO HAMILTON AAF

WETLANDS RESTORATION

Sheet reference number: 1
Sheet 1 of 1

C:\Data\AutoCAD 2000\Projects\Hamilton\Dwg\Project Files\BMKMstr.dwg

BMKMstr.dwg, 05/07/02, 09:59, SHicks

Appendix G

Preliminary Cost Estimates

U.S. Army Corps of Engineers 13-Mar-03

HAMILTON WETLAND PROJECT (ALTERNATIVE 5) & BEL MARIN KEYS V WETLAND RESTORATION PROJECT (ALTERNATIVE 2 REVISED)

Government Planning Estimate FULLY FUNDED SUMMARY

						Oct 2002 Price Level	FULLY FUNDED COST ESCALATED TO MIDPOINTS OF CONSTRUCTION	
COA		QUANTY	UOM	CONTRACT	CONTINGN	TOTAL COST	ESCALATION	TOTAL
01	LANDS & DAMAGES	1	JB	$15,918,609	$3,922,174	$19,840,783	$535,701	$20,376,484
02	RELOCATIONS	1	JB	$12,964,825	(included)	$12,964,825	$709,176	$13,674,001
11	LEVEES AND FLOODWALLS	1	JB	$58,000,188	$8,469,508	$66,469,696	$19,557,731	$86,027,427
12	NAVIGATION PORTS & HARBORS	1	JB	$149,325,135	$14,277,600	$163,602,735	$30,811,082	$194,413,817
19	BUILDINGS, GROUNDS & UTILITIES	1	JB	$159,946	$21,537	$181,483	$21,133	$202,616
30	PLANNING, ENGINEERING & DESIGN	1	JB	$21,365,000	$0	$21,365,000	$1,168,666	$22,533,666
31	CONSTRUCTION MANAGEMENT	1	JB	$17,337,193	$0	$17,337,193	$7,201,969	$24,539,162
	TOTAL PROJECT COST			$275,070,896	$26,690,819	$301,761,715	$60,005,458	$361,767,173

BASIS OF COST
Bel Marin Keys Unit V Wetland Restoration Project
Alternative 2 - Revised

1. ***Project Description:*** This estimate addresses the Alternative 2 - Revised, and is based on General Reevaluation Report (GRR) – Bel Marin Keys (BMK) Unit V of the Hamilton Wetlands Restoration Projects (December 2002), the Administrative Draft - Supplemental Environmental Impact Report/Environmental Impact Statement (SEIR/EIS) to the Hamilton Wetland Restoration Plan EIS/EIR for the Bel Marin Keys Unit V Wetland Restoration Project, the Hamilton Wetland Woodward-Clyde concept plan, reference "Hamilton Wetlands Conceptual Restoration Plan" and "Technical Appendices", prepared by Woodward-Clyde for the State Coastal Conservancy, the City of Novato, April 24, 1998, and other most current estimated and investigative information from the Civil Design(ED) and Programs and Project Management Division (PPMD) of the San Francisco District, COE.

The project consists of site improvements at Bel Marin Keys Unit V property to create a beneficial reuse site for dredged materials as part of the creation of wetlands. Improvements include freshwater, tidal and seasonal wetlands, open water habitats, flood protection levees, perimeter levees, phase containment levees, internal peninsulas, excavation and borrow material relocation, channel excavation, dredge material placement and finish grading of dredged material. Other features include building removal, construction and removal of weirs, lowering and breaching of the bayward levee, breaching the Novato Creek south side levee, hydroseeding levees, a bay trail and parking lot, and monitoring and maintenance of the site. This project is expected to be constructed with land based equipment and the dredge material offloader.

Description of Alternatives:

Alternative 1: (Dredged Material Placement with Enlarged Pacheco Pond) - Restoration of tidal marsh and non-tidal transitional marsh, seasonal wetland and upland, perennial wetland and open water habitats areas with imported dredge material.

Alternative 2: (Dredged Material Placement with Seasonal Wetlands) - Restoration of tidal marsh and non-tidal transitional marsh, and seasonal wetland and upland habitats areas with imported dredge material.

Revised Alternative 2: (Dredged Material Placement with Enlarged Pacheco Pond) - Restoration of tidal marsh and non-tidal transitional marsh, seasonal wetland and upland, perennial wetland and open water habitats areas with imported dredge material.

Alternative 3: (Natural Sedimentation with Enlarged Pacheco Pond) - Restoration of tidal marsh and non-tidal transitional marsh, seasonal wetland and upland , perennial wetland and open water habitats areas with site soil and sedimentation.

For a more complete description of the Alternatives, refer to the EIS/EIR report for this project.

2. ***Pricing:*** Estimated costs are based on an Oct 2002 price level. Plant and equipment costs are from EP 1110-1-8 "Construction Equipment Ownership and Operating Expense Schedule, Region 7" 1999 database, "Unit Price Book" (UPB) 2001 database, and "National Labor Rates" 2000 database supplied with the MCACES program. The project labor rates have been adjusted to current State of California Wage Rate Determination sheets. Fuel costs have been adjusted for this area. Material costs are from the MCACES databases, publications and previous studies. Cost estimates from the Woodward-Clyde concept plan are also used in the MCACES estimate.

3. ***Contract Work***: It was assumed that the prime contractor will perform all features of work, 5 days a week, 8 hours per day. No overtime work is anticipated at this time.

Major Construction Features Include:

4. ***Levee Construction:***

Expansion Alternatives

	Alternative 1	Alternative 2	Revised Alternative 2	Alternative 3
Earthwork				
New Levees	13,300 linear feet	15,200 linear feet	21,000 linear feet	11,400 linear feet
Improved Levees/Berms	37,500 linear feet	35,700 linear feet	36,400 linear feet	8,800 linear feet
Phase Containment Levees	30,400 linear feet	20,500 linear feet	19,200 linear feet	6,500 linear feet
Internal Peninsula/Berms	15,800 linear feet	17,900 linear feet	18,200 linear feet	26,500 linear feet
Pilot Channel Excavation	2,100 linear feet	1,800 linear feet	1,800 linear feet	1,200 linear feet

Material for levee construction would be obtained by excavating borrow material at a depth of 2 feet from designated areas within the BMK site. Material would be placed, compacted and shaped to form levees at the designated footprints. Cross-sections used in this estimate were estimated with data from the most recent investigations for Revised Alternative 2, as well as technical information from the Hamilton Wetland Restoration Feasibility Report.

The cost estimate reflects the initial construction of the levees, and the subsequent raising of said levees, in three phases/stages to address concerns from the surrounding communities. Information for the construction of the levees in stages were provided by Victor Chan - Civil Design and Edgar Salire - Geotechnical, and are as follows: (1) construction of the initial levees, (2) stage 1 construction approximately 4 years after completion of the initial construction, and (3) stage 2 construction approximately 17 years after completion of stage 2 construction. A bulking factor of 1.4 has been used where applicable per SPN Geotechnical Section.

During the Hamilton Wetland Restoration project, levees along the perimeter of the State Land (SLC) parcel and along the NSD Outfall Pipeline will be constructed during the Hamilton project to provide a separation between the Hamilton and BMK projects. After the BMK project is authorized, construction beings and the wetlands have been established, these levees will be excavated to the desired wetland restoration topographic elevation, thus

combining the Hamilton and BMK project into one. The excavated material will be used either as borrow material to either improve or raise or provide coverage material where and when necessary.

5. ***Breaching and lowering the levees***: Breaching and lowering of the existing bayward levee, and the breaching of existing levee along the Novato Creek are the proposed plan for the revised Alternative 2.

6. ***Hamilton Levee excavation:*** The levee constructed during the Hamilton project that separates the Hamilton wetland site from the Bel Marin Keys (BMK) wetland site will be excavated down to desired elevations required by the project, after the BMK project has been authorized.

7. ***Weir and Culvert structures:*** Existing weirs inadequate to provide the desired flow of water will be removed and replaced with more adequate weirs and culverts. Construction of new culverts with flapgates will provide for the transfer of water from existing water sources into the newly created wetland, and from the newly created upland transition area to the newly tidal marsh area.

8. ***Building Demolition***: The building demolition consists of demolition, removal and disposal of buildings composed primarily of wood and sheet metal materials. Buildings range from 1000 square feet to 10,000 square feet. Site specific information of the existing buildings were provided by Victor Chan, Civil Design Section, John Azeveda, consultant to the Corps for BMK V, and Eric Polson, PE , consultant to the Corps. An estimated 50% of the buildings may or may not have lead, upon consultation with Victor Chan. Cost for lead paint removal has been added to the estimate.

9. ***Mobilization and Demobilization:*** Assume all land based plant and equipment is available locally and mobilization would take 16 hours and demobilization would take 16 hours.

10. ***Monitoring:*** Monitoring consists of initial and final fill elevations for dredged material placement using resistivity staffs and remote monitoring equipment similar to Sonoma Baylands project. The cost is from the HWRP Feasibility Report cost estimate, and the Woodward-Clyde concept report.

11. ***Finish Grading:*** Finish grading of the dredged material consists of mixing the top 2' of dredged material placement to prevent complete desiccation and cracking of the top layer. It is assumed that the dredging contractors will construct the final 2 ft. finish layer with 1 ft. of sand as the first layer and the fine-grained material for the final 1 ft. layer.

12. ***Long Term Monitoring Costs:*** Long term monitoring costs of the dredge material placed is the estimated cost of monitoring the placement of the material over a period of approximately 13 years. Costs consists of monitoring and maintenance of the levees, water control structures, tidal channel depth; aerial photos, transects monitoring, biological monitoring, water quality, and sedimentation surveys for a period of 13 years. These costs were developed by the Environmental Branch and Specifications and Cost Engineering Section, SPN.

13. ***PG&E Towers:*** There are existing PG&E towers within the newly created marsh areas. This estimate includes the cost to for concrete encasements of the tower legs at the base. The costs were referenced from the Sonoma Baylands Wetlands Restoration project completed in 1994.

14. ***Pacheco Pond Expansion:*** The estimate includes the expansion of the existing Pacheco Pond with some clearing and grubbing, tree removal, and breaching of the existing Pacheco Pond levee in several locations, thereby unifying the existing and new portions of the pond.

15. ***NSD Outfall Pipeline Modifications:*** The revised Alternatives 2 requires the modification of the existing outfall pipeline through the construction of a new section of pipeline around the east side of the newly expanded Pacheco pond. The costs were estimated based upon the existing HWRP cost for relocating this pipeline per foot of line.

16. ***Bay Trail and Parking Lot:*** Costs include the construction of a new bay trail along the perimeter of the new wetland, and constructed on the new perimeter levee itself. The cost for a new parking lot is based relatively simple site grading for a new concrete slab on aggregate base, that will accommodate approximately 20 spaces for cars.

17. ***Adaptive Management:*** The cost for adaptive management monitoring for the development of the wetland is estimated at 2% of the cost for the total project cost, based upon historical data from Corps projects.

18. ***Hydroseed of Levees:*** Hydroseeding of the new levees is based on the estimated unit costs in the HWRP Feasibility Report.

19. ***Real Estate Costs:*** Developed by Mary Leotaud, CSPEK-RE Real Estate Division in Sacramento, and Susan Miller, CESPN-PM, RE San Francisco District.

20. ***Planning, Engineering and Design (PED, Construction Management (S&A) and Engineering and Design (E&D):*** PED, S&A and E&D costs were provided by Peter Mull and Lorraine Louie, CESPN-PM, San Francisco District, with consultation with the various engineering and construction services disciplines.

21. ***MCACES Assumptions:*** 7.5% home office overhead, 8% profit; 1% bond; contingencies ranging from 10% - 20%, depending on the construction task item. Contractor field cost items for the site construction are detailed in code 11 of the MCACES. Escalation of the various cost categories, i.e. Levees and Floodwalls, Navigation, Ports and Harbors, and Buildings, Grounds and Utilities have been adjusted/escalated to reflect an estimated October 2002 price level. Reference escalation factors from the Civil Works Construction Cost Index System, 20 September 2002.

BEL MARIN KEYS ESTIMATE (GRR)
BMK V Wetland Restoration
Revised Alternative Two
Marin County, California

Designed By: Jones & Stokes
Estimated By: Jeffrey Ide

Prepared By: ITR: Sherman Fong

Preparation Date: 02/28/03
Effective Date of Pricing: 02/28/03

Sales Tax: 8.3%

	QUANTY	UOM	CONTRACT	CONTNGCY	ESCALATN	TOTAL CST	UNIT
01 Lands and Damages							
01.20 Project Design Memorandum (PDM)							
01.20.03 Real Estate Analysis Documents			103,780	15,586	0	119,366	
TOTAL Project Design Memorandum (PDM)			103,780	15,586	0	119,366	
01.23 Constructn Contract(s) Documnts							
01.23.03 Real Estate Analysis Documents			39,610	5,048	0	44,658	
TOTAL Constructn Contract(s) Documnts			39,610	5,048	0	44,658	
01.99 Associated Documentation							
01.99.01 Non-Federal Costs			150,000	15,000	0	165,000	
01.99.02 Land Value			15287361	3,821,840	0	19109201	
TOTAL Associated Documentation			15437361	3,836,840	0	19274201	
TOTAL Lands and Damages	1.00		15580751	3,857,474	0	19438225	19438225
02 Relocations							
02.03 Cemetery, Utilities, & Structure							
02.03.18 Utilities			315,000	0	9,765	324,765	
TOTAL Cemetery, Utilities, & Structure			315,000	0	9,765	324,765	
TOTAL Relocations	1.00		315,000	0	9,765	324,765	324765
11 Levees and Floodwalls							
11.01 Levees							
11.01.01 Mob, Demob & Preparatory Work	1.00	JOB	364,650	54,697	14,258	433,605	433605
11.01.03 Care & Diversion of Water	1.00	JB	966,211	147,573	37,869	1,151,653	1151653
11.01.99 Associated General Items	1.00	JB	36327966	4,739,412	1,429,519	42496897	42496897
TOTAL Levees	1.00	JB	37658827	4,941,682	1,481,646	44082155	44082155
TOTAL Levees and Floodwalls	1.00		37658827	4,941,682	1,481,646	44082155	44082155

	QUANTY	UOM	CONTRACT	CONTNGCY	ESCALATN	TOTAL CST	UNIT
12 Navigation Ports & Harbors							
12.02 Harbors							
12.02.15 Mechanical Dredging			84055000	8,405,500	3,855,603	96316103	
TOTAL Harbors			84055000	8,405,500	3,855,603	96316103	
TOTAL Navigation Ports & Harbors	1.00		84055000	8,405,500	3,855,603	96316103	96316103
19 Buildings, Grounds, & Utilities							
19.00 Buildings, Grounds, & Utilities							
19.00.22 Parking Lots and Service Roads	1.00	JB	78,616	10,135	2,502	91,253	91253
19.00.49 Streets and Public Roads	1.00	JB	76,013	11,402	2,815	90,230	90230
TOTAL Buildings, Grounds, & Utilities			154,629	21,537	5,317	181,483	
TOTAL Buildings, Grounds, & Utilities	1.00		154,629	21,537	5,317	181,483	181483
30 Planning, Engineering and Design							
30.23 Constructn Contracts(s) Documnts							
30.23.01 Plans and Specifications (P&S)	1.00	EA	4,825,000	0	0	4,825,000	4825000
30.23.02 Plan Formulation/Economics	1.00	EA	25,000	0	0	25,000	25000
30.23.04 Environmental Studies Documents	1.00	EA	250,000	0	0	250,000	250000
30.23.07 Cost Estimates	1.00	EA	530,000	0	0	530,000	530000
30.23.08 Other Studies/Investigations	1.00	EA	275,000	0	0	275,000	275000
30.23.09 Contract Award Documents	1.00	EA	20,000	0	0	20,000	20000
30.23.99 Associated Constr Docs	1.00	EA	2,000,000	0	0	2,000,000	2000000
TOTAL Constructn Contracts(s) Documnts	1.00	EA	7,925,000	0	0	7,925,000	7925000
30.24 Value Engineerng Analysis Docmnt							
30.24.01 Value Engineer'n Screen'n/Studie	3.00	EA	150,000	0	0	150,000	50000
TOTAL Value Engineerng Analysis Docmnt	1.00	EA	150,000	0	0	150,000	150000
30.25 Engrg Design During Const							
30.25.01 Engrg&Design - Const support	1.00	EA	2,435,000	0	0	2,435,000	2435000
TOTAL Engrg Design During Const	1.00	EA	2,435,000	0	0	2,435,000	2435000

	QUANTY	UOM	CONTRACT	CONTNGCY	ESCALATN	TOTAL CST	UNIT
30.26 Programs & Project Managmt Dcmnt							
30.26.01 Project Coordination Documents	1.00	EA	750,000	0	0	750,000	750000
30.26.14 All Other Progrms/Proj Mgmt Docs							
TOTAL Programs & Project Managmt Dcmnt	1.00	EA	750,000	0	0	750,000	750000
TOTAL Planning, Engineering and Design	1.00		11260000	0	0	11260000	11260000
31 Construction Management							
31.23 Construction Contracts							
31.23.11 Supervision and Administration			11118920	0	0	11118920	
TOTAL Construction Contracts			11118920	0	0	11118920	
TOTAL Construction Management	1.00	EA	11118920	0	0	11118920	11118920
TOTAL BEL MARIN KEYS ESTIMATE (GRR)	1.00		160143128	17,226,194	5,352,330	182721652	********

HAMILTON WETLANDS RESTORATION PROJECT
BASIS OF COST, 3/5/03

1. Project Description: This estimate is based on Woodward-Clyde concept plan, reference "Hamilton Wetlands Conceptual Restoration Plan" and "Technical Appendices", prepared by Woodward-Clyde for the State Coastal Conservancy, the City of Novato, April 24, 1998, Winzler & Kelly, "NSD Facilities Report", May 11, 2001, and Civil Design/Geotech Section work prepared 1/30/03. The project consists of site improvements at Hamilton Army Airfield (HAAF) and the State Lands Commission (SLC) areas to create a disposal site for dredged materials and eventually to create wetlands. Improvements would include perimeter levees, peninsula levees, containment levee, and Novato Sanitary District (NSD) pipe protection levee. Other features of the project include AC pavement removal, constructing weir structures, lowering the bayward levee, breaching the bayward levee, hydroseeding levees, NSD outfall pipe construction, dechlorination plant construction, constructing outboard marsh pilot channels, monitoring, maintenance, finish grading of dredged material, and offloading of dredged material and placement costs. This project is expected to be constructed with all land based equipment.

Description of Alternatives:

Alternative 1 (No Action Plan) - Self-explanatory.

Alternative 2 (Natural Sedimentation, HAAF) - Restoration of wetlands in HAAF area by natural sedimentation and tidal flows.

Alternative 3 (Natural Gradient, HAAF) - Restoration of wetlands in HAAF area by dredged material placement and tidal flows.

Alternative 4 (Natural Sedimentation, HAAF, SLC) - Restoration of wetlands in HAAF and SLC areas by natural sedimentation and tidal flows.

Alternative 5 (Natural Gradient, HAAF, SLC) – Restoration of wetlands in HAAF and SLC areas by dredged material placement and tidal flows.

For a more complete description of Alternatives, refer to the EIS/EIR report for this project.

2. Pricing: Estimated costs are based on a October 2002 price level. Plant and equipment costs are from EP 1110-1-8 "Construction Equipment Ownership and Operating Expense Schedule, Region 7, 1999 database, "Unit Price Book" (UPB) 2001 database, and "National Labor Rates" 2000 database supplied with the MCACES program. The project labor rates have been adjusted to current State of California Wage Rate Determination sheets. Fuel costs have been adjusted for this area. Material costs are from the MCACES databases, publications and previous studies. Cost estimates from the Woodward-Clyde concept plan and Winzler & Kelly, NSD Facilities Report are also used in the MCACES estimate.

Escalation factors: are from EM1110-2-1304, rev 30 Sep 02, Quarterly Indexes Table A-1. For real estate escalation use code 11.

	Oct 98	Oct 01	Oct 02
Code 02 Relocations	-	519.56	535.69
Code 11 Levees & Floodwalls	497.88	523.80	541.56
Code 12 Navigation	-	491.92	512.43

3. Contract Work: It was assumed that the prime contractor will perform all features of work, 5 days a week, 8 hours per day.

Major Construction Features Include:

4. Levee Construction, Alternative 2 - 4:

Perimeter Levee w/tidal berm:	5,600' for Alternatives 2 and 3
	9,400' for Alternatives 4
Perimeter Levee:	4,100' for Alternatives 2 and 4
	11,000' for Alternatives 3
Peninsula Levees:	5,800' for all Alternatives 2 - 4
Containment Levee:	2,500' for all Alternatives 2 - 4
NSD Protection Levee:	2,500' for all Alternatives 2 - 4

Levee Construction for Alternative 5:

Perimeter Levees:

Segment AB	2,600'
Segment BC	1,200'
Segment CD	4,100'
Segment DH	5,600'
Segment EFG	6,300' (SLC parcel)

Peninsula Levees: 5,800'

Separator Levees (Separates Seasonal and Tidal Wetlands construction)
Segment DJ 8,100'

Material for levee construction would be obtained by excavating borrow material at a depth of 2 feet from designated areas within the HAAF site. Material would be placed, compacted and shaped to form levees at the designated footprints. Lengths of levees and cross-sections used in this estimate were from Woodward-Clyde concept plan. The quantity of borrow material identified is not sufficient to construct the levees. The estimated quantity of borrow material identified is from BRAC estimates at 2' depth. Project manager will recommend excavating up to 8' depth to makeup for any shortfall in borrow quantity. Dredged material may possibly be used also as borrow. Levee construction is expected to take 2 years. A bulking factor of 1.4 has been used where applicable per SPN Geotechnical Section.

5. Lowering the Bayward levee consists of cutting the levee top to elevation +3.5 ft; Breaching the Bayward Levee, and; Constructing the outboard marsh pilot channels allows tidal flow into the site for wetlands creation.

6. Weir structures cost is from the Sonoma Baylands wetlands restoration project done in 1994. The Sonoma Baylands project is similar in size and scope.

7. Taxiway/apron AC pavement removal consists of demoliton and removal of three sections of taxiway/apron AC pavement for the creation of the subtidal channel. The length of the sections are 269', 175' and 182'. The assumed widths are 50' and assumed depths are 5'.

8. NSD outfall pipeline construction consists of replacing the existing outfall pipeline along the current alignment with new pipe. The estimated cost used is from the Winzler & Kelly 2001 report.

9. Dechlorination plant relocation would consist of construction of two new dechlorination stations, one at each wastewater treatment plant (Ignacio Treatment Plant and Novato Treatment Plant). The estimated cost used is from the Winzler & Kelly 2001 report.

10. Building Demolition would consists of demolition, removal and disposal of buildings composed of various materials (wood, masonry, metal, concrete). Buildings range from 150 square feet to 15,000 square feet. Costs were determined using R.S. Means, Heavy Construction Cost Data. Design and costs were developed by Eric Polson, P.E., consultant for the Sponsor and COE SPN staff. Lead abatement costs are included in the demolition cost.

11. Mobilization and demobilization: Assume all land based plant and equipment is available locally and mobilization would take 16 hours and demobilization would take 16 hours.

12. Monitoring consists of monitoring initial and final fill elevations for dredged material placement using resistivity staffs and remote monitoring equipment similar to Sonoma Baylands project. The cost is from Woodward-Clyde concept report.

13. Finish Grading consists of mixing the top 2' of dredged material placement to prevent complete dessication and cracking of the top layer. It is assumed that the dredging contractors will deposit 1' of sand 1' below the final elevation and 1' of fine-grained material at the final elevation.

14. Offloading of Dredged Material and Placement Cost includes offloader operation, mobilization & demobilization, offloader platform, pipeline, electrification, offloader equipment standby and offloader labor standby for an estimated dredged material quantity of 9,900,000 cubic yards to be offloaded and placed at Hamilton/SLC sites. This cost is included in code of accounts 12, Navigation Ports & Harbors.

15. Excess Transportation Costs consists of excess transportation costs of hauling dredged material to Hamilton instead of to their traditional designated in-Bay disposal sites. The cost has been computed based on the volume of material expected to be delivered from each of the applicable navigation projects over the life of the Hamilton project.

16. Long Term Monitoring Costs consists of monitoring and maintenance of the levees, water control structures, tidal channel depth; aerial photos, transects monitoring, biological monitoring, water quality, and sedimentation surveys for a period of 13 years (Alternatives 3,5) or 20 years (Alternatives 2, 4). These costs were developed by the Environmental Branch and Specifications and Cost Engineering Section, SPN.

17. Adaptive Management Monitoring Costs for development of the wetland are estimated at 2% of total project cost based on COE historical data.

18. Real Estate Costs: Developed by Susan Miller, Carolyn Meza, and Gayle Hayes, Real Estate Division, SPK.

19. Planning, Engineering and Design (PED) and Construction Management (S&A) costs were developed by Lorraine Louie, Peter Mull, Dave Doak, PPMD, Eric Polson, P.E., and Specifications and Cost Engineering Section, SPN.

20. MCACES Assumptions: 7.5% home office overhead, 8% profit, 1% bond, and varying contingencies and escalations based on the work item. Field cost items for levee construction are detailed in code 11 of the MCACES. Work for Building Demolition, Hydroseeding, Monitoring Dredged Material Elevations, Long Term Site Monitoring, and Adaptive Management Monitoring has been identified as potential separable contracts and have been assigned separate contractor markups. All other project work has been properly classified with appropriate markups.

21. Federal/Non-Federal Costs: This MCACES cost has not been broken out into Federal and Non-Federal costs since the cost-sharing percentages have not been identified and the Federal and local sponsor responsibilities have not been identified.

22. Project Phasing:

Phase 1: The majority of work for this project is the levee construction which will take approximately 2 years to construct.

Phase 2 (Alternates 3,5 only): Offloading and placement of dredged material to created wetland would take approximately 5 years (Only the offloading and placement cost of this work is covered under this project). Some of the dredged material offloading and placement may occur during Phase 1.

Phase 3: Lowering levee, beaching levee, construction of the outboard marsh channels, weir structures removal, hydroseeding levees, finish grading and maintenance would occur during this 2-year phase and would start approximately 1 year after completion of the dredged material offloading and placement.

Phase 4 : Long term monitoring which includes sediment survey, aerial photos, transects monitoring, tidal gages, tidal data, biological monitoring and data analysis for a 13-year period after completion of the dredged material placement. Adaptive management monitoring is for a 13-year period and occurs after completion of the dredged material placement.

CONTINGENCY PERCENTAGES

1. Mobilization and Demobilization 15% percentage was determined using an average percentage for similar type work. Cost could differ depending on transfer distances, plant availability, amount of plant required, type of plant used by the Contractor, road conditions, weather and traffic.

2. Levee Construction, Lower & Breach Bayward Levee, 15% percentage was determined using an average percentage for similar type work. Construction is relatively straight forward. Cost may change since it is based on a concept plan. Revision to the concept plan, i.e., levee lengths, cross-section, breach dimensions, and cut elevations would affect quantities assumed for this estimate. Haul roads, weather and traffic are also factors.

3. Borrow Material 35% percentage was based on the availability of the borrow material. BRAC estimates approximately 550,000 cubic yards available at 2' depth. Project manager will recommend excavation up to 8' depth to makeup for any shortfall in borrow quantity. Unknown factors such as contamination, groundwater and slope stability are factors.

4. Outboard Marsh Channels 20% percentage was based on using land-based equipment for constructing the channels. Cost may increase if the dredged material is unable to support the construction equipment which would slow production and add support costs, or if dredging equipment is brought in. Affect of tides, and weather are factors.

5. Hydroseeding Levees 10% percentage was determined using an average percentage for similar type work. Construction is relatively straight forward. Concept plan did not identify mix design. Material price is a factor.

6. Weir Structures, Remove Weir Structures 20% percentage was based on the concept plan which did not identify weir structures in the design. Cost is from Sonoma Baylands wetlands restoration project weir structures and cost would differ if design is not the same.

7. Taxiway/Apron AC Removal 20% percentage was based on the assumed removal quantities. Quantities are preliminary, and AC pavement width and depth has not been established. Pavement may be asphalt or asphalt concrete according to concept plan.

8. NSD Outfall Pipeline Construction 20% percentage was based on the W&K report. Work consists of construction of a new outfall pipe to replace the existing one along the current alignment. Cost may change since it is based on a preliminary design.

9. Dechlorination Plant Relocation 20% percentage was based on the W&K report. Work consists of construction of two new dechlorination plants to replace the existing ones. Cost may change since it is base on a preliminary design.

10. Building Demolition 25% percentage was based on design and estimates by Eric Polson, P.E., consultant for the Sponsor and COE SPN staff. Building to be demolished were identified, square footage and volumes were determined for demolition, removal and disposal costs. Costs were determined using R.S. Means, Heavy Construction Cost Data. Data is consistent with MCAÇES database which is developed by R.S. Means Company.

11. Monitoring 15% percentage was based on the concept plan. This monitoring design for initial and final dredged material elevations is based on the Sonoma Bayland project which was successfully used. The cost is from Woodward-Clyde concept report.

12. Finish Grading 15% percentage was based on concept plan and BCDC input. Work is fairly straight forward. Factors include the type of dredged material that would be placed on the top 2', dryness and workability of the material, and bearing support for the equipment.

13. Offloading of Dredged Material and Placement/Excess Transportation Costs 10% percentage is based on the concept plan. Cost is determined from COE dredge estimating programs and other project data. Factors would include the dredging process (availability of equipment, type, size, fuel costs, production, material type, haul distances, etc.).

14. Long Term Monitoring Costs 15% percentage is based on the concept plan, BCDC input, and COE. Work has been done before on Sonoma Baylands project and costs were determined from Sonoma Baylands project.

15. Adaptive Management Monitoring Costs 15% for development of the wetland are estimated at 2% of total project cost based on COE historical data which indicates costs in the 1% to 2% range.

15. Field Costs for Levee Construction 10% percentage is based on construction delays, accelerated schedules, and modifications to the contract.

HAMILTON WETLAND PROJECT ALT 5
Wetlands Restoration (HAAF,SLC)
Using Dredged Materials
Marin County, California

Designed By: Woodward-Clyde/Winzler&Kelly/COE
Estimated By: Phil Pang

Prepared By: San Francisco District
Specifications/Cost Engineering

Preparation Date: 01/31/03
Effective Date of Pricing: 01/31/03

Sales Tax: 8.25%

	QUANTY	UOM	CONTRACT	CONTNGCY	ESCALATN	TOTAL CST	UNIT
01 Lands and Damages							
01 23 Constructn Contract(s) Documnts							
01 23.03 Real Estate Analysis Documents	1.00	JOB	305,400	64,700	32,458	402,558	402558
TOTAL Constructn Contract(s) Documnts	1.00	JOB	305,400	64,700	32,458	402,558	402558
TOTAL Lands and Damages	1.00	JOB	305,400	64,700	32,458	402,558	402558
02 Relocations							
02 03 Cemetery, Utilities, & Structure							
02 03.47 Structures, DECHLORINATION PLANT	1.00	JOB	1,260,000	0	39,060	1,299,060	1299060
02 03.97 NSD OUTFALL PIPE MODIFICATIONS	1.00	JOB	11000000	0	341,000	11341000	11341000
TOTAL Cemetery, Utilities, & Structure	1.00	JOB	12260000	0	380,060	12640060	12640060
TOTAL Relocations	1.00	JOB	12260000	0	380,060	12640060	12640060
11 Levees and Floodwalls							
11 01 Levees							
11 01.01 Mob, Demob & Preparatory Work	1.00	JOB	262,611	39,392	10,268	312,271	312271
11 01.03 Care & Diversion of Water	1.00	JOB	656,793	131,359	49,466	837,618	837618
11 01.99 Associated General Items	1.00	JOB	17195088	3,357,075	685,486	21237648	21237648
TOTAL Levees	1.00	JOB	18114493	3,527,825	745,220	22387537	22387537
TOTAL Levees and Floodwalls	1.00	JOB	18114493	3,527,825	745,220	22387537	22387537
12 Navigation Ports & Harbors							
12 02 Harbors							
12 02.15 Mechanical Dredging	9900000	CY	58721000	5,872,100	2,693,532	67286632	6.80
TOTAL Harbors	1.00	JOB	58721000	5,872,100	2,693,532	67286632	67286632
TOTAL Navigation Ports & Harbors	1.00	JOB	58721000	5,872,100	2,693,532	67286632	67286632
30 Planning, Engineering and Design							
30 23 Constructn Contracts(s) Documnts							

	QUANTY	UOM	CONTRACT	CONTNGCY	ESCALATN	TOTAL CST	UNIT
30 23.10 Engineering & Design During	1.00	EA	2,350,000	0	0	2,350,000	2350000
30 23.16 Preconstruc. Engineering, Design	1.00	EA	7,755,000	0	0	7,755,000	7755000
TOTAL Constructn Contracts(s) Documnts	1.00	JOB	10105000	0	0	1010500010105000	
TOTAL Planning, Engineering and Design	1.00	JOB	10105000	0	0	1010500010105000	
31 Construction Management							
31 23 Construction Contracts							
31 23.11 Supervision and Administration	1.00	JOB	6,218,273	0	0	6,218,273	6218273
TOTAL Construction Contracts	1.00	JOB	6,218,273	0	0	6,218,273	6218273
TOTAL Construction Management	1.00	JOB	6,218,273	0	0	6,218,273	6218273
TOTAL HAMILTON WETLAND PROJECT ALT 5	1.00	EA	105724166	9,464,625	3,851,270	119040060********	

Appendix H

U.S. Fish & Wildlife Service Coordination

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825

IN REPLY REFER TO:
CESAC - Bel Marin Keys
Unit V Wetland Restoration

May 16, 2002

Mr. Thomas R. Kendall
Chief, Planning Division
Corps of Engineers, San Francisco District
333 Market Street
San Francisco, California 94105-2197

Dear Mr. Kendall:

The U.S. Army Corps of Engineers (Corps), in collaboration with the California State Coastal Conservancy (Conservancy) and the San Francisco Bay Conservation and Development Commission (BCDC), is considering expanding the authorized Hamilton Army Airfield Wetland Restoration Project to include wetland restoration at the Bel Marin Keys Unit V (BMK) site, located adjacent to the Hamilton Army Airfield in Marin County. The 1,595-acre BMK site would restore several habitats including freshwater emergent wetland, seasonal wetland, high transitional marsh, tidal salt marsh, and uplands. This diverse array of habitats would presumably benefit listed species, as well as other migratory and resident species. The BMK parcel, in conjunction with the Hamilton Army Airfield parcel, would restore about 2,000-2,300 acres of habitat. Three alternatives have been selected for inclusion in the Draft Supplemental Environmental Impact Report/Environmental Impact Statement for the BMK site. These are: (1) dredged material placement with an enlarged Pacheco Pond, (2) dredged material placement with seasonal wetlands, and (3) natural sedimentation with an enlarged Pacheco Pond.

In the Scope of Work for Fiscal Year 2002, your office requested that the Fish and Wildlife Service (Service) prepare a brief Planning Aid Letter which describes our initial comments and concerns on the BMK project. Therefore, the following comments are our preliminary concerns on the proposed project. Please bear in mind that they are *preliminary*, and subject to change, as they are based on the limited information that we have at this time. More exhaustive studies will be completed by our office as we proceed with writing the Fish and Wildlife Coordination Act report, conducting the Habitat Evaluation Procedures, completing a thorough contaminants assessment, and consulting with your office under section 7 of the Endangered Species Act.

Recommended fundamental elements of tidal restoration design
Loss of tidal marsh habitat in the San Francisco Bay area has been extensive and has resulted in severely decreased populations of species dependent on this habitat. Remaining and created tidal marsh habitat in the San Francisco Bay is critical to the survival of these species. Therefore, Alternative 3 is currently our preferred alternative with regards to the habitat distribution, since it has the greatest amount of tidal marsh habitat. However, the expansion of Pacheco Pond at the

expense of habitats that would better benefit marsh species is not acceptable. Some additional high transitional marsh and seasonal wetland in this area and along the perimeter levees would provide refuge for marsh species during extreme high tide events.

Full tidal exchange and natural sedimentation are preferable primary methods for tidal restoration at the BMK site for the following reasons: (1) placement of dredged material at this scale, and project dependence on imported dredged materials, would cause unacceptable loss of restoration project control because of linkage with dredge disposal needs, permit and environmental regulatory uncertainties of dredging projects (e.g., Montezuma Wetlands), and long construction delays with site preparation and disposal; (2) though declining, the pool of available fine sediment in San Pablo Bay is abundant, and would remain abundant during the expected wetland development period; and (3) the adjacent extensive tidal mudflats and marshes are already erosional.

Selective placement of imported dredged material would be potentially useful for construction of wide, gently sloping terraces or benches along the interior edges of the restoration. Based on observation of inadvertent alluvial fans (dredge discharge sediment cones) at Sonoma Baylands, we recommend deliberate hydraulic placement of coarse-grained dredge material (coarse silt, fine sand) to form inexpensive, extensive alluvial terraces along the edge instead of earthmoving. These gently sloping gradients would provide for rapid, wide natural marsh accretion along the periphery of the intertidal zone, and would naturally dissipate wave energy, favoring deposition rather than erosion of sediment under the influence of internal wave energy.

Additionally, we recommend against emergent wavebreak berms with artificial patterns, similar to those at Sonoma Baylands. Wave energy damping should rely on bed roughness of residual vegetation, and irregular, randomized placement of topographic highs. Topographic highs should be intertidal, and support bed roughness by native marsh vegetation. Emergent wavebreaks (upland artifacts) artificially facilitate unacceptable dispersal and foraging of terrestrial predators. Artificial controls of tidal drainage patterns may result in unpredictable constraints and simplification of naturally complex channel variables with very high ecological significance (variation in channel sinuosity, drainage density, pan density and size, channel branching, etc.).

Finally, outboard dikes should be graded down to the upper limits of tidal influence to create high marsh, rather than unflooded terrestrial habitat. Erratic uplands at unnatural locations provide unacceptable nuclei for invasive nonnative plants which may degrade future high marsh habitat quality, and are likely to facilitate dispersal and foraging by non-native terrestrial predators.

Contaminants Concerns

Contaminants could potentially be present in the BMK parcel. The Phase I Preliminary Environmental Site Assessment (Erler and Kalinowski, Inc. 2000) summarizes the work done to characterize the site prior to property transfer. Sediment samples collected from the central and western regions of the property in 1989 did not have detectable concentrations of organochlorine

pesticides, herbicides, polychlorinated biphenyls (PCBs), or petroleum hydrocarbons, although the reporting limits were unacceptably high for several analytes. In addition, no analysis of 2,4-Dichloro-phenoxyacetic acid (2,4-D) metabolites or potential contaminants, including 2,3,7,8 congener (TCDD), was included even though 2,4-D use was documented on the site. Furthermore, no sampling was done around the sheds, which were likely used for pesticide storage and farm vehicle maintenance activities, the three above ground fuel tanks, the refuse pile in the northeast corner, or the tire pile in the eastern portion. Maximum total mercury concentrations in the dredge spoil piles from BMK (range 0.181-0.496 milligrams/kilogram [mg/kg]) exceed the 0.35 mg/kg total mercury criteria for wetland cover use (CRWQCB 1995). Petroleum hydrocarbons (diesel, gasoline, JP-4) and TCDD toxic equivalents (TEQ) were detected, and chromium, molybdenum, silver, thallium, selenium, and copper were above the Hamilton Army Airfield background criteria in the western property boundary area, which is the North Antenna Field that is adjacent to the BMK parcel.

Several aspects of the alternatives allow for potential input of contaminants from adjacent areas to enter the marsh system. Stormwater outflows from Pacheco Pond, the New Hamilton residential area, and Bel Marin Keys Lagoon could all potentially introduce household and industrial contaminants into the restoration area. Any outflow from adjacent lands and Landfill 26 area should not be added onto the wetland. One option would be confinement of the runoff into a perimeter drainage canal along the levees (western edge of Hamilton airfield parcel and along Bel Marin Keys Lagoon) to prevent potential introduction of contaminants and also to provide perennial flow in a ditch along each levee to reduce human and predator access to the restoration area. Another option would be to transport this water through the existing Novato Sanitary District pipeline and pump it out into the San Pablo Bay at the outfall. Bel Marin Keys Lagoon outflow could also be pumped out via the pump station as in Alternative 3.

Similarly, the Service is concerned about potential mobilization of contaminants remaining on-site in Hamilton Army Airfield and North Antenna Field areas. The contamination present in both the airfield and North Antenna Field has not yet been fully characterized. In addition, although the Corps is excavating known "hot spots" in the area of primary channel cuts in the airfield area and putting dredged material over other areas, the Service is not assured that all potential mobilization of contaminants has been recognized and prevented. The creation of an upland area in the North Antenna Field area as a remediation for lead contamination remaining in place is not a satisfactory solution. This upland area requires space that would preferably be tidal marsh habitat. In addition, the levee breaches to the airfield (Alternative 2) and the primary channel cut through the North Antenna Field (Alternative 1) increase the likelihood of contaminant mobilization and would allow movement of any mobilized contaminants into the entire restoration area.

If dredged material is used to more rapidly elevate the marsh plain, the material would need to be sufficiently characterized, and not have chemicals present at concentrations sufficient to cause adverse effects to wildlife.

Integration of flood protection and tidal marsh restoration
Flood protection for any adjacent developed areas should be designed to integrate fully with restoration designs, and flood engineering and habitat engineering designs should be developed by fully integrated teams. We envision wide, sloping levees as continuous with high tidal marsh ecotones.

Interim wetland management
We recommend that the diked baylands at the BMK site be managed as a mix of seasonal and perennial marsh during the interim period prior to tidal restoration. An example of the result of simple cessation of pumping and drainage, allowing groundwater elevations to fluctuate above and below the existing subsided surface, is found at Cullinan Ranch (located at the San Pablo Bay National Wildlife Refuge), a diked bayland with similar subsidence. The principal benefits from a mix of open seasonal ponds with low-growing emergent vegetation (dwarf spikerush, annual native forbs) and tall perennial emergents (cattail, tule) can be inferred from this example. Cullinan Ranch provides rich habitat for dabbling ducks, migratory shorebirds, wading birds, and some breeding resident shorebirds. The development of wetland soils and biomass can arrest or gradually reverse subsidence. The matrix of tall, persistent perennial vegetation would provide significantly enhanced bed roughness for several years to facilitate tidal sedimentation after tides are restored. Local deep pond excavation may be consistent with on-site borrow fills for some essential pre-construction of earthen features of the tidal restoration designs.

Fresh wastewater discharges
We recommend that the fresh wastewater discharges associated with the dechlorination plant be rigorously re-examined for their potential to be routed through ecotonal freshwater/brackish wetlands in transition to tidal wetlands, to provide important local salinity gradients which would otherwise be unavailable. We note that the historic tidal wetlands at the site were connected to riparian freshwater drainages which discharged into large marsh ponds.

Alternative designs to incorporate compatible habitat for shorebirds and waterfowl
Rather than construct separate artificially impounded, nontidal habitats dedicated to shorebirds and waterfowl, we recommend restoration designs which integrate shallow seasonally ponded and perennial shallow water habitats with the restored tidal marsh. High marsh pans, marsh edge pans, and deeper ponds, based on the best available interpretations of natural remnant features in the central coast region, and historic geographic evidence, should be considered as priorities for shorebird and waterfowl habitat.

Integration of public access and tidal marsh restoration
The Service recognizes the need to incorporate compatible public access in urban estuarine reserves, to provide valuable opportunities for public education, nature interpretation, esthetic enjoyment, and wild scenic values of restored tidal marshes. Poorly designed public access, particularly recreational perimeter trails, however, may eliminate some of the most ecologically important habitat functions of restored tidal marshes. We recommend emphasis of short loop trails or spur trails that provide marsh viewing to elevated platforms, blinds, or interpretive

stations. Because of unacceptable uncertainties in the enforceability and compliance with leash laws, we recommend that alternative upland dog exercise areas be provided away from the marsh; all pets should be prohibited from marsh edge access. Jogging trails, similarly, should be constructed away from marsh edges. Fishing access to subtidal waters should be provided to discourage pedestrian access or degradation of marsh habitat.

At this time, the trail system in Alternative 1 is preferred since it does not fully edge the restoration area. The trail system should also be lined with a fence that is buried at the bottom and a water-filled "moat" should be constructed inside of the fence to minimize access by humans, pets, and predators, including feral animals. The levee for the Novato Sanitary District pipeline should also be gated and preferably have a drawbridge over water to prevent unauthorized access and predator movement. The levees also act as a barrier to the movement of small animals between the parcels and if levee breaches do occur, they should have gradually sloping sides to promote native marsh vegetation. This will allow a migration corridor for salt marsh harvest mice that otherwise would have to cross the top of a sparsely vegetated levee with increased risk of predation.

The Service recommends that the Corps, Conservancy, and BCDC incorporate these comments, concerns, and recommendations into their planning process as the currently selected alternatives are analyzed more closely. If you have any questions concerning this letter, please contact Caroline Prose at (916) 414-6575.

Sincerely,

Michael B. Hoover

Michael B. Hoover
Acting Field Supervisor

Enclosure

cc:
FWS, AES, Portland, OR
FWS, San Francisco Bay NWR Complex, Newark, CA
FWS, San Pablo Bay NWR, Vallejo, CA
USACE, San Francisco, CA (Attn: Eric Jolliffe)
NMFS, Santa Rosa, CA
CDFG, Region II, Yountville, CA
California State Coastal Conservancy, Oakland, CA
San Francisco Bay Conservation and Development Commission, San Francisco, CA
EPA, San Francisco, CA
Jones and Stokes Associates, Oakland, CA

LITERATURE CITED

Erler and Kalinowski, Inc. 2000. Phase I Preliminary Environmental Site Assessment for California Quartet property, Bel Marin Keys Unit V, Marin County, California. Prepared for California Quartet, LLC. San Francisco, California.

CRWQCB (California Regional Water Quality Control Board). 1995. Wetlands Creation Cover Disposal Option Sediment Screening Criteria. San Francisco, California.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825

IN REPLY REFER TO:
CESAC - Bel Marin Keys
Unit V Wetland Restoration

September 30, 2002

Mr. Thomas R. Kendall
Chief, Planning Division
Corps of Engineers, San Francisco District
333 Market Street
San Francisco, California 94105-2197

Dear Mr. Kendall:

The U.S. Army Corps of Engineers (Corps), in collaboration with the California State Coastal Conservancy (Conservancy) and the San Francisco Bay Conservation and Development Commission (BCDC), is considering expanding the authorized Hamilton Army Airfield Wetland Restoration Project to include wetland restoration at the Bel Marin Keys Unit V (BMK) site, located adjacent to the Hamilton Army Airfield in Marin County. The 1,595-acre BMK site would restore several habitats including freshwater emergent wetland, seasonal wetland, high transitional marsh, tidal salt marsh, and uplands. This diverse array of habitats would presumably benefit listed species, as well as other migratory and resident species. The BMK parcel, in conjunction with the Hamilton Army Airfield parcel, would restore about 2,000-2,300 acres of habitat. Three alternatives have been selected for consideration: (1) dredged material placement with an enlarged Pacheco Pond, (2) dredged material placement with seasonal wetlands, and (3) natural sedimentation with an enlarged Pacheco Pond.

Per a request from staff at your agency, this letter serves to demonstrate that staff from our office are coordinating with staff from your office on the BMK project. A Habitat Evaluation Procedures (HEP) team has been formed to include staff from the Fish and Wildlife Service (Service), Corps, California Department of Fish and Game (CDFG), and BCDC. The team has met several times to discuss the HEP process, select Habitat Suitability Index (HSI) Models, discuss methodology to collect the data in the field, etc. and has also met several times at the BMK site to collect field data. The team will need to spend several more days in the field to collect data, and attend meetings to analyze the data and predict future HSI values for both without and with the project conditions, prior to the draft Fish and Wildlife Coordination Act (FWCA) report being completed.

Staff from your office has requested that we provide a best estimate of when the draft FWCA report will be completed. At this time, a date is difficult to predict, but taking into account the amount of work that still needs to be performed, our estimate is sometime in December, at the earliest. As the work progresses and more information is collected, it will be easier to predict a more accurate completion date.

If you have any questions concerning this letter, please contact Caroline Prose at (916) 414-6575.

Sincerely,

David L. Harlow
Acting Field Supervisor

cc:
FWS, AES, Portland, OR
FWS, San Francisco Bay NWR Complex, Newark, CA
FWS, San Pablo Bay NWR, Vallejo, CA
USACE, San Francisco, CA (Attn: Eric Jolliffe)
NMFS, Santa Rosa, CA
CDFG, Region II, Yountville, CA (Attn: Eric Tattersall)
California State Coastal Conservancy, Oakland, CA
San Francisco Bay Conservation and Development Commission, San Francisco, CA
(Attn: Brenda Goeden)
EPA, San Francisco, CA
Jones and Stokes Associates, Oakland, CA

Appendix I

Draft
Conceptual Monitoring and Adaptive Management Plan

Bel Marin Keys Unit V Expansion of the Hamilton Wetland Restoration Project
DRAFT CONCEPTUAL MONITORING AND
ADAPTIVE MANAGEMENT PLAN

INTRODUCTION

After construction is completed the site will be monitored for a period of 13 years to ensure that the site is maturing and performing as designed. The Corps of Engineers will participate in the monitoring and adaptive management program for 13 years after the end of construction. Subsequent inspection and surveillance of the project in connection with its obligation for operating, maintaining, repairing, rehabilitating and replacing the project will be the responsibility of the non-Federal Sponsor.

At any time during the 13-year monitoring period, if the results of monitoring indicate that any features of the constructed project require modification or if new features are required for the project to perform as intended, then adaptive management measures may be implemented. This plan provides a general framework for monitoring and managing the success of the Bel Marin Keys Unit V Expansion of the Hamilton Wetlands Restoration Project after construction. Included is guidance for monitoring levee performance, site hydraulics including channel and creek morphology, biological success, public health (mosquito breeding habitat), and water quality. This conceptual plan will be greatly expanded and quantified in the detailed design phase of the study.

It should be noted that a separate operation and maintenance (O&M) manual will be prepared by the Corps and provided to the Sponsor upon completion of construction. O&M tasks will be performed by the Sponsor to ensure that the project features are maintained in their as-built condition (or as modified by adaptive management measures) for the entire project life.

This plan covers the period after the completion of construction. Prior phases of the project include the detailed design phase and the construction phase. The SEIR/EIS identifies specific project features and mitigation measures to be implemented during the design phase (such as development of specific trail designs or development of a water management plan) or to be implemented during the construction phase (such as pre-construction nest surveys). Maintenance and monitoring during construction (e.g., spill prevention, erosion control, discharge of decant water, avoidance of special-status species) will be further described in the plans and specifications for construction. Testing of sediments for contaminants and evaluation of sediment quality will be completed by responsible parties for proposed dredged material for reuse and the DMMO prior to transportation to the site during the construction phase.

At the beginning of the post-construction phase period, dredged material will have been placed and the outboard levees breached.

Contemporaneously with the commencement of the Monitoring and Adaptive Management Period, the non-Federal Sponsor will assume exclusive responsibility for the performance and funding of the operation, maintenance, repair, rehabilitation, and replacement of the project, and the two programs will run concurrently. The distinction between the Sponsor's maintenance, repair, rehabilitation, and replacement responsibilities, on the one hand, and the adaptive management activities shared for the 13-year period by the Government and the Sponsor, on the other hand, will be determined as the detailed Monitoring and Adaptive Management Plan and the OMRRR Manual are developed.

Monitoring of biological, hydrological, topographic, bathymetric, and water quality conditions will track the evolution of the site after breaching of the outboard levees. Periodic comparisons of measured

conditions with expected conditions will determine whether the development of the site is progressing as planned.

Restoration goals and objectives for the project are qualitative statements in the SEIR/EIS regarding expected future conditions. Quantitative standards intended to measure progress towards these goals and objectives will be developed later for the detailed monitoring, and adaptive management plan.

LEVEES AND WATER MANAGEMENT STRUCTURES

Monitoring

SETTLEMENT. Monitoring of settlement of the levees due to foundation consolidation should be performed annually by means of precision level surveys of settlement monuments installed during construction. The greatest rate of settlement is expected to occur during the first ten years after the levees are constructed. The data should be reduced, plotted, and compared with the expected design rate. Settlement monitoring of the levees should continue annually until the analyses of the survey data shows that the rate and amount of settlement are within design expectations. At that time the frequency of settlement monitoring may be adjusted to longer intervals of time. If the rates and amount of settlement are unacceptable, then corrective measures should be recommended and action taken.

ANNUAL INSPECTIONS. During the first few years after breaching of the outboard levees, a walkover inspection of the levees and water management structures should be performed twice annually for pre- and post-winter conditions. Subsequently, the frequency of inspection of levees can be reduced to one annual post-winter inspection. The reduced frequency would be based upon determining that the performance of the levee features, and of the site in general, are in accordance with design expectations. Inspection of water management structures should continue on a twice-annual schedule.

The inspection should look for erosion problems such as rills, gullies, and other evidence of erosion on the newly constructed levees, and for evidence of burrowing mammals. Burrowing mammals, when present in large enough numbers, are detrimental to the overall stability of a levee. Burrowing mammals should be eradicated when infestations endanger the perimeter levee system, and the damage repaired. The breach openings should also be inspected for any obstructions or debris that would limit tidal flows. The walk over inspection should document the implementation of previously recommended corrective actions (or the lack thereof) and the effectiveness of that action.

The inspection of water management structures should look for structural integrity, settlement vegetation accumulation, sediment accumulation, or other features that may impede operation of the structure.

The annual inspections may be supplemented as necessary following a major storm event or an earthquake of magnitude 5 or greater located within 50 miles of the project, or a smaller magnitude event if specific reports of local damage are received.

CROSS SECTIONS. Surveyed cross-sections of the perimeter levees and any waterside, wave-erosion protection berms should be performed annually until they have stabilized, but no less than five years after the breaching of the outboard levees. Supplemental surveys should be made after a severe storm event or a major El Nino winter.

INSPECTION REPORT. An inspection report should be written for each inspection documenting the observations and finding, recommended corrective action items, and actions taken. In general, the monitoring and inspection report should include but not be limited to the following:

A. A site map indicating the areas of significant findings and/or observations.

B. Condition of the breaches, once they are created, noting obstructions and debris.

C. Condition of the levees and any recent repairs, noting any unusual, abnormal, or unexpected conditions or occurrences that could bear on the effectiveness of the structure.

D. Results of the settlement monitoring and interpretation of the data.

E. Condition of hard structures, water management structures (such as culverts or weirs), and pipelines.

F. Condition of access and service roads, especially areas where problems are likely to develop.

G. Availability of emergency supplies necessary for immediate repairs of major storm related damages.

H. An emergency action plan that includes phone numbers and means of contacting operating personnel.

I. Corrective measures taken (date temporary measures taken, permanent repairs, etc.) and the cost of corrective actions for the report period.

J. A summary of findings, proposed corrective actions, and an implementation plan for those actions.

Maintenance and Adaptive Management

Corrective actions in response to problems identified when monitoring levee conditions as described in the section on monitoring, above, may entail either maintenance activities or adaptive management activities. The distinction between these two categories of activities will be developed in greater depth in the detailed Monitoring and Adaptive Management Plan and the OMRRR Manual, respectively. Corrective actions could include adding material to compensate for excessive settling or erosion, repair of earthquake damage, reinforcing the levee surface to withstand erosion in problem areas (to the minimum extent necessary), repair of drainage structures, or control of burrowing rodents. Any rodent-control efforts will need to be carefully planned and executed to avoid negative impacts on adjacent habitats and wildlife. Such efforts would be confined to levees; rodent populations in other habitat areas including berms would not be controlled except under unusual conditions.

HYDRAULICS

Monitoring

DREDGED MATERIAL FILL ELEVATION AND TIDAL SEDIMENTATION. The surface elevation of the dredged material fill after consolidation will be an important determinant of the success of the project. Proper development of the tidal marsh requires that the fill elevation be low enough to allow additional sedimentation and development of tidal channels on the site after breaching of the outboard levees. If significant portions of the fill are placed above the intended elevation, formation of small marsh channels will be inhibited and the eventual quality of the marsh habitat will be reduced. In contrast, if the fill elevation is lower than intended, the only negative impact would be a delay in marsh development while additional sedimentation raises the grade level to the intended elevation.

Dredged material placed on the site will consolidate over time, with the fastest consolidation occurring initially. The degree of consolidation and its duration will depend upon the texture and depth of the dredged material. By the time that the outboard levees are breached, most consolidation will have already occurred. During the next several years, some additional consolidation may occur and could counteract tidal sediment deposition during that period.

While monitoring the surface elevation of the fill material during and immediately after completion of placement is important, this is part of the construction process and is not part of post-construction monitoring. Measurement of the fill elevation as part of the post-construction monitoring of the site will commence upon the breaching of the outboard levees, and will continue thereafter primarily to measure ongoing sedimentation on the site. These elevation data will also provide the baseline for measuring the physical development of the marsh plain and channels following the introduction of tidal action.

Monitoring of sediment deposition rates and patterns will provide useful information regarding the accuracy of predictive sedimentation models and will help to quantify the acceleration of marsh restoration achieved by using dredged material. This information will be important in future decisions regarding the use of dredged material in marsh restoration projects. Information regarding sediment deposition patterns will also assist in understanding changes in vegetation patterns as the marsh develops and will provide a basis for evaluating the effectiveness of the interior peninsulas in accelerating sediment deposition. The techniques to be used in monitoring site elevations will be determined during the detailed design stage, but could include transects across the site and/or resistivity staffs as used at the Sonoma Baylands project.

EXTERIOR TIDAL CHANNELS. To provide initial tidal access to the site, channels will be excavated to connect the site to the waters of San Pablo Bay and Novato Creek. These channels will be large enough to provide substantial tidal circulation, but will be smaller than the final equilibrium size. As the tidal hydrology of the site and its connecting channels evolves, the channels are expected to increase in size until they reach equilibrium with the tidal prism of the site. As the tidal prism eventually decreases due to sedimentation on the site, the channels will decrease in size in response. To ensure that the site is developing properly, the geometry of these channels will be monitored periodically and will be compared to expected conditions.

NOVATO CREEK CHANNEL MORPHOLOGY. To provide tidal exchange to the site, a breach will be constructed in the outboard levee to connect the site to Novato Creek. Additionally, during high flow periods, outlet flows from Pacheco Pond will be diverted to provide a source of freshwater for the seasonal wetland habitat area. These activities may result in changes in Novato Creek channel morphology (i.e., creek width and depth); although based on study to date, the changes are expected to be favorable in terms of navigation (due to the addition of tidal prism) and less than significant in terms of habitat and levee stability. Baseline conditions will be monitored for several years prior to breach of the BMKV/Novato Creek levee. The geometry of the Novato Creek channel will be monitored annually at designated locations upstream and downstream of the site and compared to the baseline conditions to quantify the magnitude of these changes. Specific monitoring locations will be determined during the detailed design phase. If monitoring identifies any significant adverse changes in channel morphology (e.g., excessive project-related sediment deposition, or erosion of adjacent levees), adaptive management measures will be identified and implemented as appropriate. Monitoring of the Novato Creek channel will be coordinated with the Bel Marin Keys Community Services District, given the interest of the BMK community in navigation via the channel and due to the periodic dredging of the channel by the BMK CSD.

TIDAL REGIME. The intent of the project is to create a tidal marsh with physical and biological conditions similar to natural marshes in the general area. The creation and maintenance of a normal tidal

regime is a very important component of restoration, as tidal action and suspended sediment circulation are essential to the creation and maintenance of tidal marsh topography and vegetation. The progress of the site's tidal regime towards reference conditions will be monitored using appropriate recording equipment. Measurements of tide elevations will be recorded periodically or continuously at locations within the site and at a nearby reference location. The tidal regime and tidal prism will be determined from these measurements.

INTERNAL PENINSULA CREST ELEVATIONS. The internal peninsulas are intended as temporary features to reduce wind and wave fetch, direct tidal flows away from levees, and encourage sedimentation. They are expected to gradually erode away and eventually disappear. The elevation of the peninsula crests will be periodically measured to monitor their progress towards specified standards.

INTERNAL CHANNEL DEVELOPMENT. Tidal channels are the most important physical feature of a tidal salt marsh. The extent, pattern, and density of the channel system determines many other attributes of the marsh, including hydrology, vegetation distribution, and habitat values. It is therefore important to document these attributes of channel development in the Hamilton restoration project for use in the design of future wetland restoration projects.

Channel development will be mapped from aerial photographs taken during appropriate tidal conditions. Transects may also be useful in measuring the development of these channels.

Maintenance and Adaptive Management.

Corrective actions in response to problems identified when monitoring project hydraulics may entail either maintenance activities or adaptive management activities. The distinction between these two categories of activities will be developed in greater depth in the detailed Monitoring and Adaptive Management Plan and the OMRRR Manual, respectively. Corrective actions will consist of removal of any debris that obstructs tidal flows.

WATER QUALITY

Water quality parameters to be monitored will include salinity, temperature, and dissolved oxygen. Measurements will be taken at several locations within the site and in the connecting channels. Due to the substantial tidal exchange that should exist immediately after breaching, water quality should be comparable to that in adjacent parts of the bay. If water quality deficiencies are substantial and persistent, remedial actions will be developed and implemented if practicable.

Additionally, a specific monitoring and adaptive management plan will be developed and implemented to address methylmercury production and accumulation in the restoration site. The plan including specific monitoring parameters (e.g., duration, frequency, constituents, protocols) will be developed in consultation with the responsible regulatory agencies. The purpose of the monitoring would be to determine whether methylmercury concentrations are found at substantially greater concentrations in the water column, sediments, or benthic invertebrate populations at the restoration site than at reference sites. Corrective actions, if required, will be developed and implemented in consultation with the responsible regulatory agencies.

Implementation of the project will also require coordination with the Marin County Flood Control Water Conservation District and the California Department of Fish and Game to ensure that any water quality monitoring aspects related to the new water management plan for Pacheco Pond are implemented. The

development of a new water management plan will be part of the design phase, but its implementation would occur after construction.

BIOLOGICAL RESOURCES

Monitoring

MARSH DEVELOPMENT (FROM MITIGATION MEASURE BIO-8). The Corps, in conjunction with the Conservancy or its successors in interest, will develop and implement a monitoring and adaptive management program to measure the rate of tidal coastal salt marsh establishment and the quantity and quality of established coastal salt marsh. Restored coastal salt marsh will be monitored annually for the first 5 years, and again in years 10 and 15 following breaching of the outboard levees. The Corps and Conservancy (or its successor) would be responsible for the first 5 years of monitoring and the monitoring in year 10. The Conservancy (or its successor) would be responsible for monitoring in year 15, because it is beyond the 13-year Corps monitoring period. The monitoring program will be designed to determine whether coastal tidal marsh is developing and whether its primary supporting physical processes (i.e., tidal exchange and sedimentation) are occurring at the estimated rate during the first 15 years following completion of construction. Subsequent inspection and surveillance of tidal salt marsh development at year 15 and beyond will be the responsibility of the non-Federal Sponsor in connection with its obligation for operating, maintaining, repairing, rehabilitating, and replacing the project. Because it will occur beyond the 13-year Project monitoring period, the Conservancy will independently assume (including on behalf of any successors) the responsibility for monitoring in year 15, in addition to its obligation to conduct inspection and surveillance of the project.

Major elements of the monitoring program will include the following:

- Measure the extent of tidal coastal salt marsh removed to determine the amount of tidal coastal salt marsh that would need to be restored to compensate for loss of tidal coastal salt marsh at an in-kind replacement ratio of 2 acres restored for every acre of tidal salt marsh removed.

- Monitor parameters, including tidal stage, tidal current, wind speed and direction, wave characteristics, suspended sediment concentrations, sedimentation rates and distribution, marsh elevations, mudflat elevations, areal extent and locations of established or colonizing salt marsh vegetation, composition and density of established and colonizing plant species, characteristics of subtidal channel and marsh surface sediments, and San Pablo Bay shoreline characteristics.

- Monitor locations, including the tidal wetland interior, tidal wetland perimeter, subtidal channels, and existing San Pablo Bay marsh shoreline.

- Compare predicted and measured site development and function.

- Analyze monitoring data to identify possible reasons for differences between observed and predicted conditions.

- Recommend corrective actions that could be implemented if the restoration is not proceeding as designed.

Monitoring reports will be submitted by the Conservancy, Corps, or successors in interest to the DFG, USFWS, and NMFS by November 1 of each year in which monitoring of the development of coastal tidal salt marsh is done.

At the end of the initial 5-year monitoring period, if the development rate of the coastal salt marsh and the habitat quality of establishing coastal salt marsh do not appear to conform to the goals and projections established for the project, or do not appear sufficient to replace each acre of removed tidal coastal salt marsh with 2 acres of contiguous in-kind habitat within 10-years of levee breach, the Corps, in conjunction with the Conservancy or its successors in interest, will review the proposed BMKV expansion with representatives of DFG, USFWS, and NMFS to obtain input as to whether additional monitoring, adaptive management actions, or modifications are necessary to ensure the functions and values of the affected coastal salt marsh habitat will be replaced. The Corps, in conjunction with the Conservancy or its successors in interest, may initiate a similar review of marsh development following completion of monitoring in year 10 if the Corps or Conservancy concludes that additional actions or modifications are necessary to meet restoration goals. The Conservancy or its successors in interest, may initiate a similar review of marsh development following completion of monitoring in year 15 if they concludes that additional actions or modifications are necessary to meet restoration goals.

Monitoring or morphologic evolution will allow the Corps, in conjunction with the Conservancy or its successors in interest, to assess the success of habitat development and make decisions regarding corrective measures if necessary. Potential corrective measures include changing the breach and subtidal channel dimensions, altering perimeter levee berm morphology, and modifying channel characteristics within the restored tidal wetlands to ensure adequate morphologic evolution.

USE BY BIRDS. As intertidal mudflat and marsh habitats develop along with associated invertebrate fauna, use of these habitats by birds should gradually become similar to usage occurring on nearby intertidal habitats. As seasonal wetlands develop, winter use by waterfowl and shorebirds should become similar to such use on nearby seasonal wetlands. Periodic bird surveys will document trends in use of the site by birds in comparison to a nearby reference site and will provide an indication of the success of habitat restoration.

USE BY FISHES. Fish surveys early in the restoration process will document the initial suitability of the site for fishes. Ongoing surveys will document continued use of the site by fishes as marsh and channel formation occur.

USE BY ENDANGERED SPECIES (CALIFORNIA CLAPPER RAIL AND SALT MARSH HARVEST MOUSE). As marsh and channel development progress, habitats for the California clapper rail and the salt marsh harvest mouse are expected to gradually develop. After suitable habitat has developed over a portion of the site, periodic surveys will document the extent of these habitats and the presence of these species. Surveys will be coordinated with the U.S. Fish and Wildlife Service and the California Department of Fish and Game to ensure compliance with endangered species laws and regulations.

BENTHIC MACROINVERTEBRATES. Development of a benthic macroinvertebrate community should occur rapidly after the initial establishment of tidal action on the site. The presence of a thriving benthic macroinvertebrate community (together with abundant fish and bird populations) will indicate that the site is ecologically healthy even if it has not yet developed substantial tidal marsh habitat. However, the composition of this community can be expected to change rapidly and unpredictably due to normal natural fluctuations, which would lessen the value of monitoring trends in these species. Surveys of benthic macroinvertebrates will be conducted during the first year after breaching to document the colonization of the site by these species. Additional surveys may be conducted later if site deficiencies arise.

SEASONAL WETLAND, EMERGENT MARSH, AND OPEN WATER (FROM MITIGATION MEASURE BIO-9). The Corps, in conjunction with the Conservancy or its successors in interest, will develop and implement a 5-year monitoring program to measure the establishment rate, quantity, and quality of brackish open water, emergent marsh, and/or seasonal wetlands.

Major elements of the monitoring program will include the following.

- Measure areal extent and locations of established or colonizing marsh vegetation.
- Measure composition and density of established and colonizing plant species.
- Compare predicted and measured site development and function.
- Analyze monitoring data to identify possible reasons for differences between observed and predicted conditions.
- Recommend corrective remedial actions that can be implemented if the restoration is not proceeding as designed.

Monitoring reports will be submitted by the Conservancy, Corps, or successors in interest to DFG and USFWS by November 1 of each year in which monitoring of the development of seasonal wetland and emergent marsh areas is conducted. If the rate, quality, and quantity of created habitat are not meeting restoration goals at the end of the 5-year period, the sponsoring agencies will consult with CDFG and USFWS as regards to further monitoring and potential corrective actions.

Maintenance and Adaptive Management

Corrective actions in response to problems identified when monitoring biological resources conditions may entail either maintenance activities or adaptive management activities. The distinction between these two categories of activities will be developed in greater depth in the detailed Monitoring and Adaptive Management Plan and the OMRRR Manual, respectively. The focus in non-tidal areas will be directed towards encouraging appropriate native plant species and minimizing the presence of exotic plant species of particular concern such as non-native cordgrass, pampas grass, broom, and yellow star thistle. Corrective techniques may include mowing, burning, manual removal of unwanted plants, and herbicides (approved by the federal Environmental Protection Agency for use in wetlands) if needed. Mowing and manual removal have been effective so far at suppressing unwanted upland plant species at the Sonoma Baylands project, and herbicides have not been necessary. Any vegetation-control efforts will need to be carefully planned and executed to avoid negative impacts on adjacent habitats and wildlife. Control of non-native predators (feral cats and/or red foxes) may also be needed. A plan for controlling noxious plant species and non-native predators will developed in coordination with California Department of Fish and Game and U. S. Fish and Wildlife Service.

Biological maintenance in tidal areas will primarily be passive, with natural processes allowed to gradually restore habitats. However, tidal areas (and uplands) may be invaded by the non-native perennial pepperweed (*Lepidium latifolium*). Control of this plant is uncertain and cannot be guaranteed. Herbicides would most likely be required in any attempt to control this species, should it invade the site.

PUBLIC HEALTH (MOSQUITO BREEDING HABITAT)

Monitoring and management activities associated with potential creation of mosquito breeding habitat will be coordinated with the Marin-Sonoma Mosquito and Vector Control District. Activities may include: development and implementation of water management strategies to reduce site suitability for mosquito breeding (e.g., introduction of saline water); air and ground applications of Bti (*Bacillus thurigiensis var. israelensis*), methoprene growth regulators, or other Environmental Protection Agency approved pesticides as needed; ongoing monitoring of larval and adult mosquito populations, water quality, and vegetation density, and implementation of control and management measures as determined by MSMVCD.

ADAPTIVE MANAGEMENT

Adaptive management is a term that has been used to mean various things. As used here, it is an approach to resource management in which management goals remain the same, but management objectives and techniques may be modified in response to feedback (such as monitoring results) from the system being managed. Adaptive management recognizes that human knowledge regarding biological and physical systems is limited and that these systems may not always behave as expected. When a management or restoration project is to be implemented but there is some uncertainty regarding the response of the system to particular actions, adaptive management provides a way for management actions to respond to feedback from the system being managed. Adaptive management will be implemented if specific restoration standards are not met or if it appears that actual conditions will diverge sufficiently far from intended conditions to threaten the achievement of overall project goals. Funding for adaptive management will be included in the project cost estimates so that this option will be available in the future if needed.

Should the development of the site fail to meet quantitative standards to be stated in the detailed monitoring plan, action to correct these shortfalls will be undertaken if such action could reasonably be expected to assist in the achievement of these standards. Corrective action could include vegetation management, predator management, topographic modifications such as creation of or enlargement of channels, or levee repairs or modifications. Once corrective actions are taken, they become part of the completed project and will be maintained during and after the 13-year monitoring period as prescribed by the O&M manual.

Appendix J

Original Alternative 2

(prior to public review)

Appendix J
Alternative 2, prior to public review period

1.0 Alternative 2 – Dredged Material Placement with Seasonal Wetlands

1.1 Restoration Features

Alternative 2 consists of the authorized Project and the BMKV increment, as described prior to the public comment period. Figure J-1 depicts Alternative 2 at maturity. Under Alternative 2, a diverse array of tidal (tidal marsh, tidal flat, subtidal) and nontidal (high-transitional marsh, seasonal wetlands, upland) habitat types would be restored to the expansion site. Imported dredged material that has been determined to be suitable wetland cover according to DMMO requirements would be used to create upland and seasonal wetland habitats, and to create surface elevations suitable to accelerate the initial establishment of tidal marsh vegetation. Final marsh plain elevations would develop over time through the natural deposition of sediments from San Pablo Bay, supporting the establishment of tidal marsh vegetation.

In the eastern portion of the BMKV parcel, two tidally influenced sub-basins, each approximately 600 acres in size, would be created as cells to facilitate the placement of dredged material and the establishment of tidal wetland vegetation. Dredged material would be placed in each sub-basin to create surface elevations ranging from approximately 2 feet NGVD (approximately 1 foot below MHW) along the basin perimeter to 0 NGVD near the outboard levee. Additional dredged material would be placed in the southeast corner of the BMKV parcel to create surface elevations (approximately 3.5 feet NGVD) suitable for the establishment of high-transitional marsh vegetation. After placement activities have been completed, the outboard levees would be breached in two locations to restore the hydrologic connections to San Pablo Bay and Novato Creek. The levee along Novato Creek would also be lowered to facilitate overflow onto the expansion site from Novato Creek during peak storm events. The levee along San Pablo Bay would also be lowered to create topographic diversity and facilitate the establishment of high-transitional marsh vegetation. Final marsh plain elevations would be established through the deposition of fine-grained sediments from San Pablo Bay and Novato Creek. Final surface elevations in the two marsh sub-basins would range from approximately 0.5 to 3.5 feet NGVD. Elevations in the channel bottoms would ultimately be lower, particularly at the breach.

A levee would be constructed across the northwestern portion of the BMKV parcel to separate the non-tidal and tidal habitats. The outboard (east) side of the levee would be constructed with a gentle side slope that would transition from upland to high- to mid-marsh habitat types. The inboard (west) side of the levee would slope gradually from the crest at 10 feet NGVD to a base elevation 1 foot NGVD. The existing levee along the BMK south lagoon would be improved (approximate top elevation of 6 feet NGVD) and an overflow structure or structures would be installed to convey overflow into the swale area. Overflow from the lagoon as well as seasonal precipitation would support the establishment of approximately 40 acres of seasonal wetland habitat in the swale located between the two levees. Plant species composition in this area would vary according to

salinity and inundation frequency and duration; however, vegetation would likely consist of emergent wetland vegetation (e.g., bulrushes, cattails, rushes), and grasses and forbs.

In the northwestern portion of the BMKV parcel, approximately 170 acres of seasonal freshwater wetlands would be created by constructing a levee to impound freshwater flows. The levee would also prevent the seasonal wetland habitat area from being inundated during high tides. An adjustable weir would be installed in the existing Pacheco Pond levee to facilitate overflow into the seasonal wetland habitat area when surface water elevations in Pacheco Pond exceed the managed surface water elevation. A culvert structure would be installed in the new levee to allow the release of overflow waters from the seasonal wetlands into the tidal marsh basin. A significant portion of Pacheco Pond flood flows may be released into the seasonal marsh area and from there into the tidal marsh basin.

As for Alternative 1, the salinity of the water in the channel flowing through the tidal marsh basin would vary, depending on the outflow from Pacheco Pond and the extent of tidal inundation. As water is released from Pacheco Pond following large winter storm events, salinities within the channel would vary from freshwater values near the overflow to brackish and marine levels as water flows into the marsh basin. During extreme high tides, the channel would be inundated by tidal flow and salinity would increase to near marine levels. The seasonal wetlands would not be affected during these periods because the flapgate would prevent tidal flows from entering the pond. During the summer months and dry times of the year, the salinity of water in the channel would be comparable to that found in San Pablo Bay.

Under this alternative, a new or retrofitted outfall pipeline would be installed along the berm (the existing alignment) that separates the BMKV parcel from the adjacent HAAF parcel. The existing pipeline would be replaced or retrofitted because of differential settling and leakage. The new pipeline would be installed slightly below the grade of the existing pipeline; the existing outfall pipeline would be abandoned in place to provide protection from scour associated with the formation of tidal channels.

1.2 Recreation Features
Under this alternative, the Bay Trail would be extended southward from the terminus of the existing trail at the pump station near the Hamilton baseball field, along the southwestern perimeter of the HWRP to a point approximately 700 feet from the existing outboard marsh. This trail alignment is similar to that described for Alternative 1. Public access would also be provided by a trail that follows the existing Pacheco Pond levee, connecting the proposed Bay Trail segment along the southwest boundary of the HAAF parcel to Bel Marin Keys Boulevard. A permanent bridge would be installed to facilitate access across the new weir structure. An optional spur of the Bay Trail would be located along the proposed levee separating the upland buffer/swale area from restored tidal wetlands. This spur would terminate at Novato Creek, and a gate would be installed at the Novato Creek terminus to prevent trail users from entering the BMK residential area.

In addition, under this alternative, an interpretive center for the HWRP and BMKV expansion would be constructed on the northwestern portion of the BMKV parcel, south of Bel Marin Keys Boulevard. A paved road would connect the center to Bel Marin Keys Boulevard. The interpretive center is conceptually envisioned as an approximately 1,000-square foot building housing exhibits that provide information about the wetland restoration projects and the local flora and fauna. Restrooms and limited parking (10-20 spaces) would be provided. The interpretive center would serve as a trailhead and would be connected to the proposed Bay Trail alignment via new trails routed along existing dirt roads. The interpretive center is not a part of the federal project, and as such would be the full responsibility of the non-Federal sponsor.

1.3 Summary of Changes to Authorized HWRP

The following changes to the authorized HWRP will occur if Alternative 2 is implemented:

- Elimination of levee between BMKV and SLC parcels
- Replacement of levee between HAAF and SLC parcels with an access berm
- Repositioning of the breach location off the SLC parcel
- Increase and change in location of high transitional marsh on the SLC parcel.

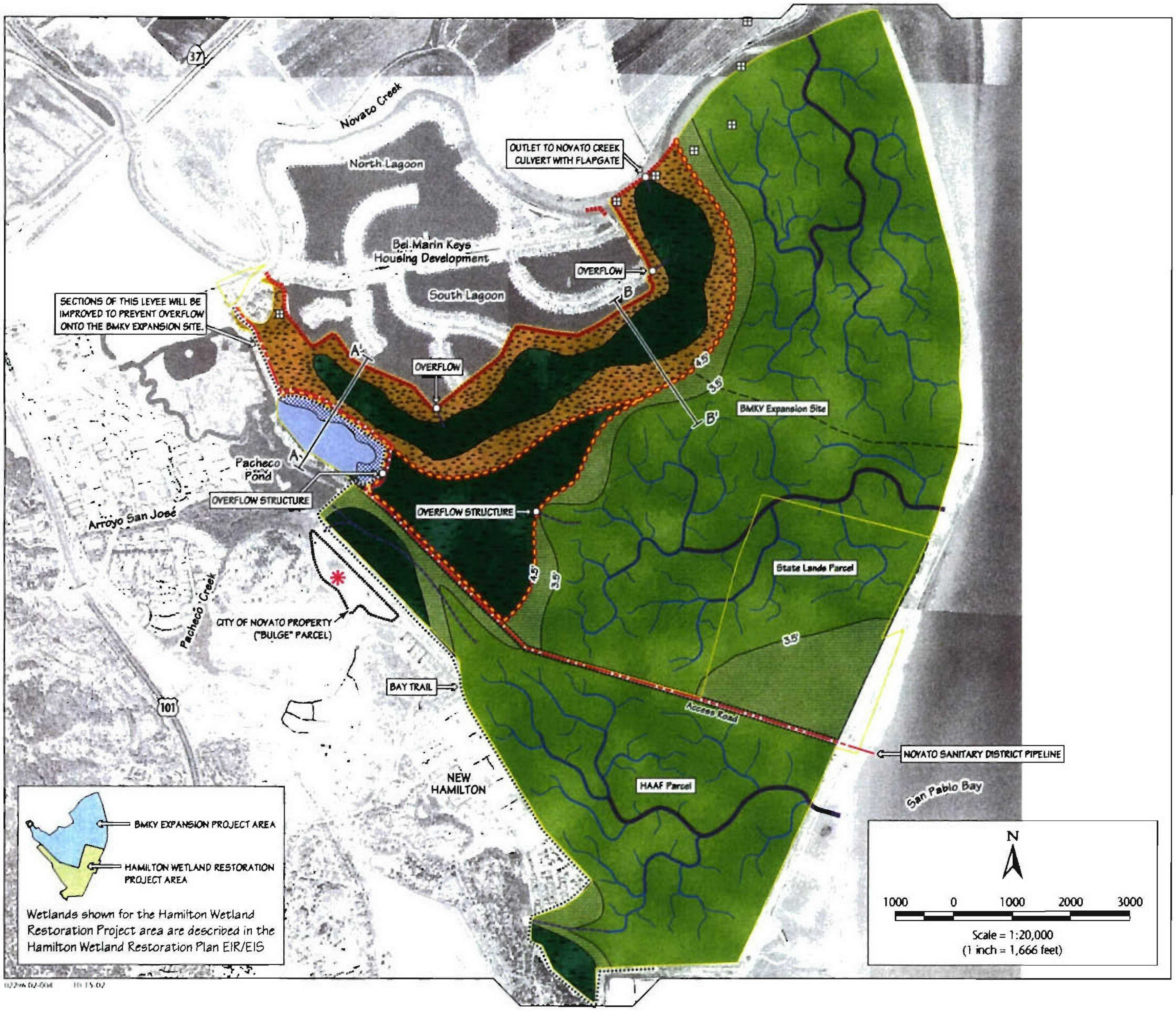


Figure J-1
Bel Marin Keys Restoration
Alternative 2 at Maturity

Legend

HABITAT TYPES
- Upland Transition
- Freshwater Emergent Wetland
- Seasonal Wetland
- High Transitional Marsh
- Tidal Salt Marsh
- Open Water

CHANNEL ORDER
- Primary channels
- Secondary channels
- Tertiary channels
- Small branches
- Sub-basin Boundary

INFRASTRUCTURE
- Parcel Boundary (see inset)
- Overflow Channel and Structure
- New Levee
- Improved Levee
- Existing Levee
- Bay Trail
- Power Tower
- Novato Sanitary District Pipeline
- Interpretive Center (access area adjacent, not shown)

Notes:

Vertical elevations are relevant to NGVD 1929.

Sections of the levee north of Pacheco Pond will be improved to prevent overflow onto the BMKV expansion site.

See Figure 3-6 for cross sections A–A' and B–B'.

Jones & Stokes

nhc